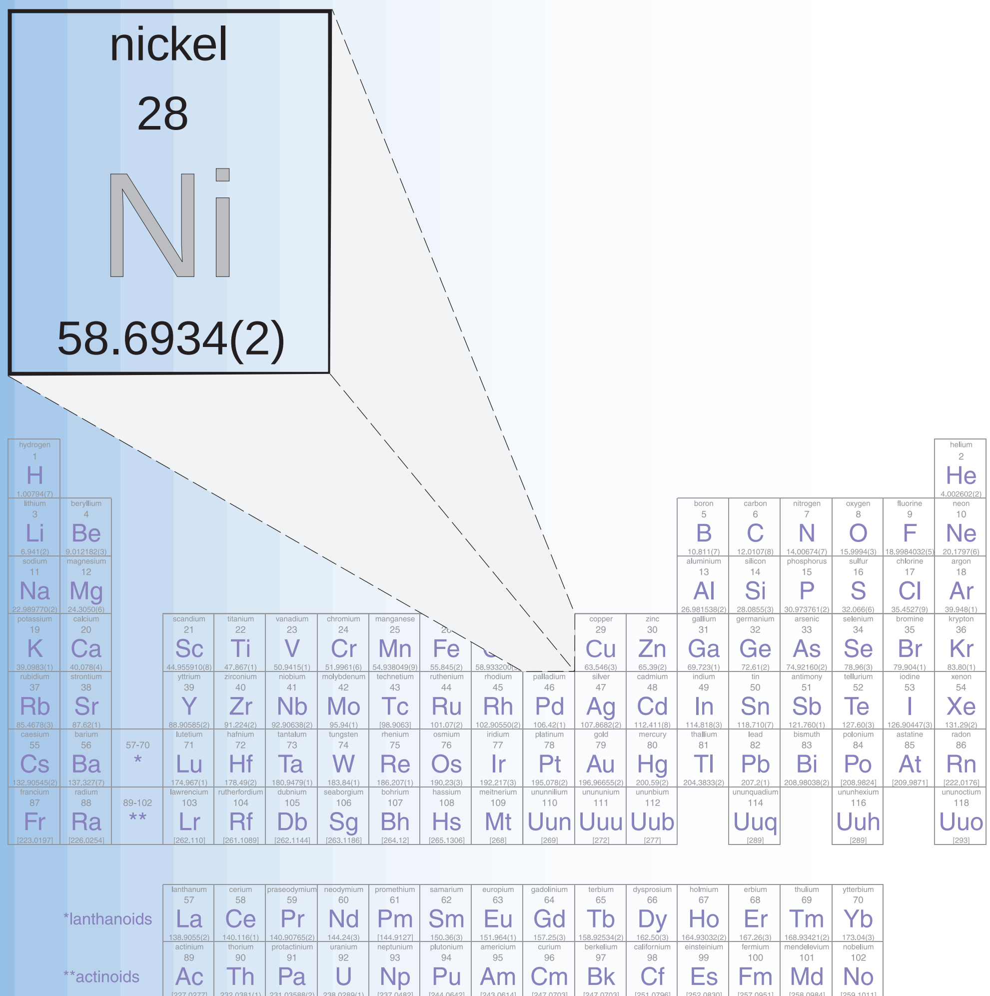
TASK 10
NICKEL ACTION PLAN



Final Report - August 23, 2000
(Revised February 2001)

Prepared by

TETRA TECH, INC.

ROSS & ASSOCIATES
ENVIRONMENTAL CONSULTING, LTD.

EOA, Inc.

Sponsored by

CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY

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ADDENDUM

A principal feature of the Nickel Action Plan (NAP) is the identification of specific actions that will be taken to ensure that existing water quality is maintained, beneficial uses are protected, and exceedances of the site-specific water quality objectives for nickel do not occur in Lower South San Francisco Bay. These actions are presented in Tables 4-1 and 4-2 of this document. The California Regional Water Quality Control Board, San Francisco Bay Region incorporated these specific actions into the Waste Discharge Requirements issued to the Cities of San Jose, Sunnyvale, and the Palo Alto on October 18, 2000. A copy of the order amending the Waste Discharge Requirements is included as Appendix 2 of this revised document.

1.0 BACKGROUND AND ASSUMPTIONS

In January 1998, the *Calculation of Total Maximum Daily Loads (TMDL) for Copper and Nickel Project* was initiated by the San Francisco Regional Water Quality Control Board with funding from the City of San Jose. The TMDL project is being carried out through the TMDL Work Group (TWG) using a stakeholder process operating as part of the Santa Clara Basin Watershed Management Initiative's Bay Monitoring and Modeling Subgroup.

The initial step in the TMDL process was the assessment of whether designated beneficial uses are being protected and whether applicable water quality objectives are being attained and, if they are not, the site specific objectives (SSO) that must be achieved to protect the beneficial uses. The key findings of the TWG's Impairment Assessment Report[1] are:

- Impairment to the beneficial uses of the Lower South San Francisco Bay (LSSFB) due to ambient concentrations of copper and nickel is unlikely

- The current state of scientific knowledge is sufficient to establish a SSO for dissolved nickel in the range of 11.6 to 20.5 μg/L

The purpose of the Nickel Action Plan is to serve as a non-degradation plan to ensure that 1) existing water quality is maintained, 2) beneficial uses are protected, and 3) exceedances of the site-specific water quality objectives for nickel do not occur in the LSSFB.

Significant reductions to pollutant loading have been accomplished through the improved treatment technologies implemented at wastewater treatment facilities, industrial pre-treatment programs, basinwide pollution prevention efforts, and actions taken by urban stormwater programs. For example, between 1980 and 1989, the amount of nickel discharged in wastewater treatment facilities' effluent declined from about 12,000 kg/yr to 5,400 kg/yr due to improved treatment operation and technology. In addition, between 1982 and 1999, the amount of nickel entering the Bay from wastewater treatment facilities has been reduced to approximately 1,700 kg/yr.

The objective of the Nickel Action Plan is to identify "triggers" that would initiate additional measures/actions, and to set forth a proactive framework for addressing increases to future nickel concentrations in LSSFB, if they occur. The Nickel Action Plan is a companion document to the Copper Action Plan (Tetra Tech et al, 2000). For purposes of uniformity, this document adheres closely to the format of the Copper Action Plan. However, the situation for copper and nickel in the LSSFB is quite different. The average concentration of dissolved nickel in the Bay (4.0 μg/L) is considerably less than the lower value of the range of proposed site specific objectives (11.6 μg/L), and the likelihood of a two-three fold increase in dissolved nickel concentrations is small. For this reason, there is less emphasis in the Nickel Action Plan on describing specific actions that would be taken to reduce nickel releases to the Bay.

[1] "Task 2. Impairment Assessment Report for Copper and Nickel for South San Francisco Bay". Final Report - June 2000. Tetra Tech, Inc., EOA, Inc., Ross & Associates.

Elements of the Nickel Action Plan

There are four elements to the Nickel Action Plan:

1. **Definition and Approach.** This section outlines the purpose of the Nickel Action Plan, describes the approach for tracking changes in environmental concentrations of nickel, and implementation plan.

2. **Description of Ambient Conditions and Nickel Sources.** Section 2 provides a summary of existing knowledge on nickel concentrations in LSSFB as well as information on loadings. This section contains the technical basis for predicting changes in ambient concentrations of nickel resulting from changes in source loading (i.e., background, point sources, tributaries, and internal cycling).

3. **Recommended Indicators, Triggers for Actions, and Monitoring Options.** Section 3 evaluates possible indicators and recommends triggers, future indicators, and monitoring activities that together form the basis for implementation of actions contained in Section 4.

4. **Identification of a Set of Actions and a Plan for Implementation.** Section 4 sets forth phased activities to be taken in the event that environmental conditions trigger these phases.

Definition and Approach

There are two parts to the Nickel Action Plan. The first part describes the Nickel Action Plan implementation steps. The second part describes the Nickel Action Plan update process.

Nickel Action Plan Implementation Steps. Seven steps have been identified for the implementation of the Nickel Action Plan (Figure 1):

Step 1. The first step is the creation of the Nickel Action Plan (this document). A plan for actions that can be taken if warranted are described in Section 4 of this plan. Priority levels are described that determine under what conditions and the order in which actions will be undertaken:

- **Baseline Actions:** These actions include 1) programmatic actions by public agencies, 2) tracking special studies that address specific technical areas of uncertainty identified in the Impairment Assessment Report and the Nickel Conceptual Model Report, 3) planning-type studies to track, evaluate, and/or develop additional indicators to use and future potential indicators and triggers (i.e., indicators for growth, development, or increased use or discharge of nickel in the watershed).

- **Phase I Action:** Phase I Actions are implemented when the value of selected monitoring parameters exceeds specified criterion values (referred to as the Phase I Trigger Levels as described in Section 3). The exceedance of Phase I Trigger Levels indicates a negative trend in water quality, not actual impairment. Phase I Actions consist of both specific remedial actions and the planning for the implementation of further actions if Phase II Trigger Levels are exceeded. Phase I Actions will fulfill the requirements and demonstrate consistency with existing anti-degradation policy.

- **Phase II Action:** Phase II Actions are implemented when the value of selected monitoring parameters exceeds a second-level criterion value (referred to as the Phase II Trigger Levels as described in Section 3). These actions are intended to reduce controllable sources further to maintain compliance with site-specific water quality objectives.

Step 2. Two fundamental components of the Nickel Action Plan are monitoring and pollution prevention actions. Two types of monitoring are included: ambient water quality monitoring and source monitoring. The water quality monitoring component is intended to provide a baseline to ascertain changes in water quality, to reduce uncertainties regarding nickel concentrations in the LSSFB and its tributaries, to provide adequate information for future impairment assessments, and to provide a sound scientific basis for future regulatory actions. The purpose of the source monitoring is to better identify the sources of nickel to LSSFB and to ascertain changes in these sources. Existing pollution prevention source control programs will continue as part of baseline actions.

Step 3. The Executive Officer and staff of the Regional Water Quality Control Board working in conjunction with NPDES permittees will review the monitoring program results annually and determine whether the trigger values have been exceeded. The Executive Officer will report findings to the Regional Board and will notify interested agencies and interested persons of these findings and will provide them with an opportunity for a public hearing and/or an opportunity to submit their written views and recommendations. The Executive Officer and staff of the Regional Board are strongly encouraged to utilize the collaborative, stakeholder process embodied in the Santa Clara Valley Watershed Management Initiative in the review process.

Step 4. If the trigger values for ambient nickel concentrations, or other indicators subsequently developed, have not been exceeded, the monitoring program will continue to provide information for the next review period. Performance of the monitoring program will be evaluated during the annual review to determine if the necessary information is being provided. If ambient concentrations exceed Phase I trigger levels, the process proceeds to Step 5.

Step 5. If Phase I trigger levels are exceeded, affected parties, as directed by the RWQCB will develop work plans and implement Phase I actions and begin planning for Phase II actions.

Step 6. If ambient concentrations do not exceed the Phase II Trigger Levels, the monitoring will continue while the action items identified in Step 5 are being implemented. If the ambient concentrations exceed Phase II Trigger Levels the process proceeds to Step 7.

Step 7. If Phase II Trigger Levels are exceeded additional control measures must be adopted to further reduce nickel loading and reverse trends in ambient nickel concentrations. The Regional

Board will notify affected parties of the necessary changes in their annual work plans and permits. If the Phase II action items involve organizations that are not subject to a water quality permit program the Regional Board will enter into an educational and negotiation process with the potentially affected parties for the purpose of implementing Phase II action items.

Nickel Action Plan - Update Cycle. The Nickel Action Plan must be updated to incorporate lessons learned from action items that have been implemented and scientific and technical information from other sources. The Nickel Action Plan update process is described below and illustrated in Figure 2. The update process makes use where possible of existing processes and forums. The process is based on the procedures developed for the WMI's Copper/Nickel TMDL Workgroup. The update of this plan can be completed as part of the regular review of conditions in LSSFB at the time NPDES permits are reissued. The Nickel Action Plan would be updated every five years if the NPDES schedule is adopted. The update process would begin 360 days prior to NPDES permit reissuance for the SCVURWD program and 180 days prior to NPDES permit reissuance for POTWs so that the updated results could be incorporated into the reissued permits. It is important to note that if revisions are needed prior to the five-year update the Regional Board can amend the Nickel Action Plan through permitees annual work plans or other regulatory actions.

The updated Nickel Action Plan will be evaluated within the context of the technical products used to develop it, including the TMDL loading analysis, conceptual model, and impairment assessment. The Regional Board is strongly encouraged to utilize the collaborative, stakeholder process in the Nickel Action Plan update process.

1. The Nickel Action Plan will be reviewed every five years as part of the NPDES permitting process.

2. The review will be based on an examination of the TWG reports for the Copper and Nickel TMDL Project and the Nickel Action Plan. The purpose is to evaluate and refine the findings of these documents for ongoing modification of the recommended actions. The uncertainties of the loading analysis, conceptual model, and impairment assessment will be reviewed as additional monitoring and scientific studies become available for LSSFB. Nickel Action Plan control measures will be evaluated using criteria which include effectiveness, cost, and uncertainty as more experience is gained from regional and national application of existing and proposed control measures.

3. Information for the review will come from the dischargers through their monitoring programs and other information gathering requirements of their NPDES permits, and from other public sources such as the WMI.

4. An information clearinghouse will be identified for organizing and maintaining the accumulated information. The information clearinghouse set up by the Initiative to support it's Watershed Action Plan will be considered to fulfill this function.

5. The review will be conducted using a collaborative stakeholder process. A workgroup similar to the Copper/Nickel TMDL Work Group should be formed to undertake the five-year Nickel Action Plan update. Like the TMDL Workgroup it would be a temporary assignment lasting only the length of time necessary to develop recommendations for RWQCB consideration. The Nickel Action Plan Work Group would be charged by the Initiative to evaluate the compiled information. The review will be based on the TMDL technical reports. The purpose of the review is to incorporate the latest scientific and technical information to continue to reduce uncertainties identified in the TMDL technical reports. The five-year Nickel Action Plan update process ensures that triggers and indicators are consistent with the latest scientific understanding available for LSSFB.

   The five-year Nickel Action Plan update will also review the phase priority assigned to each nickel loading control measure. The purpose of the phase priority is to assign each control measure (i.e., action item) to a trigger value that will determine when either planning or implementation will proceed for that measure. The phased priorities are adjusted by the workgroup based on the latest information available on the effectiveness, cost, and uncertainties associated with each control measure.

   The workgroup consensus recommendations on the TMDL technical reports, trigger levels, and action item priorities will be forwarded to the RWQCB for their consideration and action (e.g., modification of NPDES permits and or the Basin Plan).

6. The RWQCB will evaluate the Nickel Action Plan Work Group recommendations for revisions of the Nickel Action Plan that would then be incorporated into NPDES permits and the Basin Plan.

7. Affected parties would then implement the Nickel Action Plan control measures. Revisions to control measures may include the modification or elimination of existing control measures that have proven to be ineffective in reducing nickel loading or not cost-effective. Also, new control measures may be added to those that are already in existence.

The updated Nickel Action Plan would include an optimized set of control measures to be implemented for baseline water quality maintenance, Phase I action items, and Phase II action items. This edition of the Nickel Action Plan assigns a priority to each of the control measures included in the initial review (Section 4).

Definitions Used in the Nickel Action Plan

Adaptive Management Process - Adaptive management is a systematic approach to improving management by implementing policies experimentally, learning the outcomes of management interventions, and documenting the results (Taylor et al. 1997). It isn't simply changing management policies when they don't work. Rather, it is a planned approach to reliably learn why management actions or strategies (or critical components of them) succeed or fail.

Cost: One of three criteria used to evaluate Nickel Action Plan control measures and to determine phase priority status. Cost evaluation is based on both the overall control measure cost and the cost per unit reduction in nickel loading to LSSFB.

Effective: One of three criteria used to evaluate Nickel Action Plan control measures and to determine phase priority status. Effectiveness is based on the ability of a control measure to make significant reductions in nickel loading to LSSFB. Significant reduction is one that when combined with other control measures would lead to a measurable reduction in dissolved nickel concentrations in LSSFB.

Indicator–a measurable quantity that is so strongly associated with particular environmental conditions that the value of the measurable quantity can be used to indicate the existence and maintenance of these conditions.

Trigger–the numerical value of the indicator that initiates a defined intervention or action.

Lower South San Francisco Bay (LSSFB)–that portion of the bay south of the Dumbarton Bridge.

Baseline Action: Nickel source loading control measures that are already in place or will be initiated now as directed by permit requirements or pollution prevention policies.

Phase I Action: These actions are described in the Nickel Action Plan and are taken when the first trigger level is exceeded. These actions are designed to stop any further increase in ambient nickel concentrations. Phase I actions generally have lower costs and less uncertainty that Phase II actions. Implementation planning for Phase II actions begins when the first trigger level is exceeded.

Phase II Action: These actions are described in the Nickel Action Plan and are taken when the second trigger level is exceeded. These actions are designed to reduce ambient concentrations of nickel in LSSFB (i.e., return to baseline). Implementation planning for Phase II actions begins when Phase I Action levels are exceeded.

POTWs–publicly owned treatment works (wastewater treatment facilities) owned by the Cities of San Jose/Santa Clara, Sunnyvale, and Palo Alto.

Uncertainty: One of three criteria used to evaluate Nickel Action Plan control measures and to determine phase priority status. Uncertainty refers to lack of knowledge about specific factors, parameters, or models used in the decision-making process.

Urban Stormwater Program–Santa Clara Valley Urban Runoff Pollution Prevention Program.

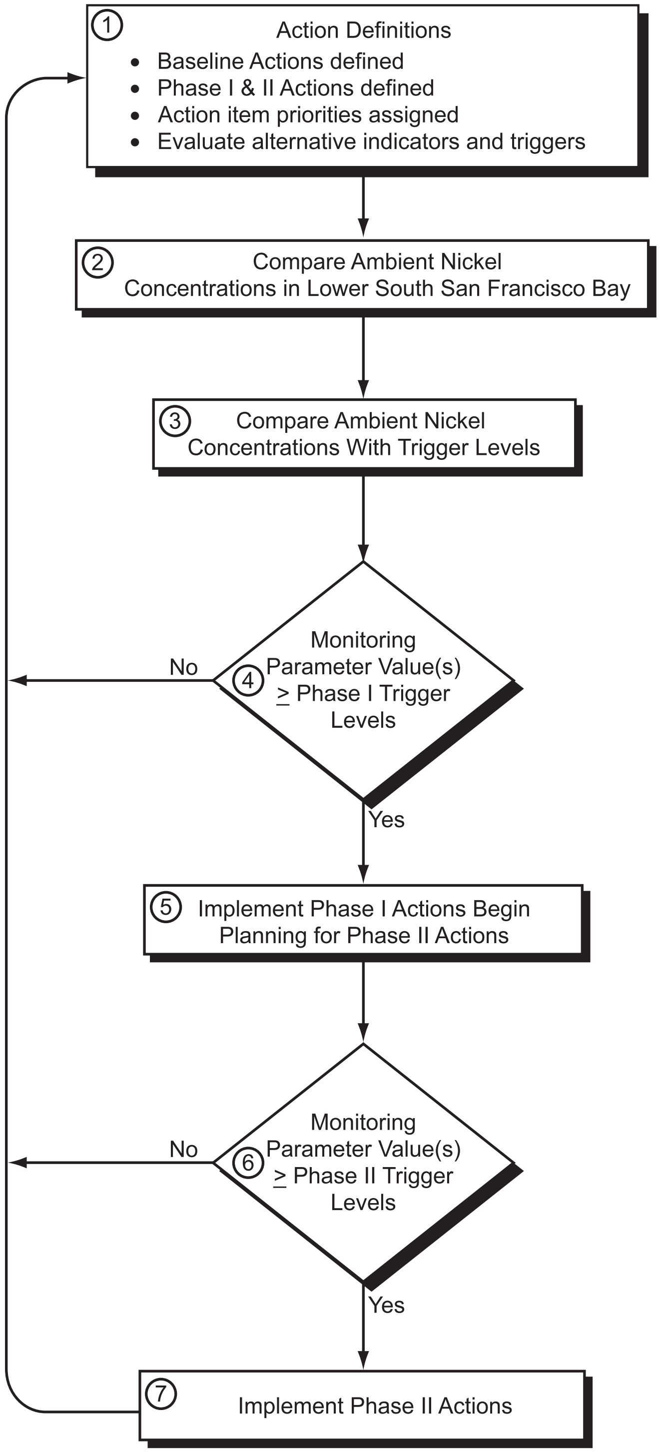


Figure 1-1. Implementation of the Nickel Action Plan Annual Cycle.

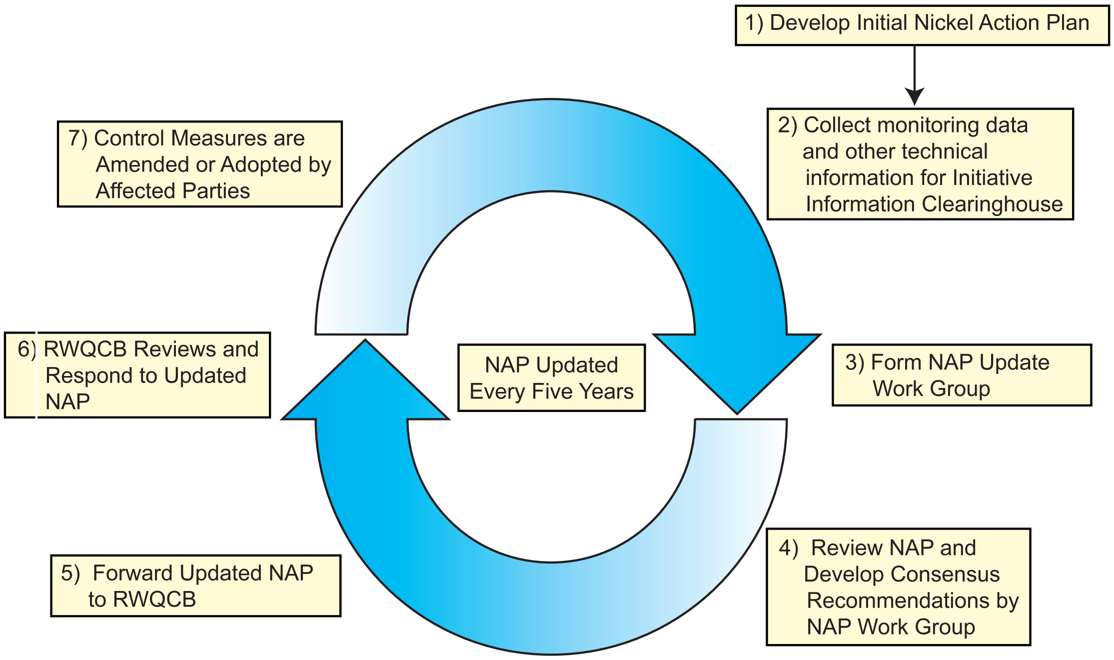


Figure 1-2. Nickel Action Plan (NAP) Adaptive Management Process.

2.0 DESCRIPTION OF AMBIENT CONDITIONS AND NICKEL SOURCES

The analyses presented in this section summarize existing knowledge of the relative importance of individual nickel sources to Lower South San Francisco Bay. The estimates focus on current loading rates from the watershed, since present day loading rates are different from those in the past. For example, over 20 years ago, POTWs contributed approximately 12,000 kg/yr of nickel to Lower South San Francisco Bay. Today, the POTWs contribute 1500 kg/yr, about 12 percent of the loadings 20 years ago. This section of the Nickel Action Plan also includes estimates of changes in ambient dissolved nickel concentrations associated with changes in inputs from POTWs and urban runoff. The results were obtained using a mass balance model. Finally, the relationship between growth measures (e.g., population in Santa Clara County, registered automobiles in Santa Clara County, automobile miles traveled, etc.) and estimated loading is discussed. The ability to use growth measures as "leading indicators"/environmental sentinels is also discussed.

2.1 Nickel Sources to Lower South San Francisco Bay

Table 2-1 summarizes estimated loading rates of nickel into Lower South San Francisco Bay. Estimates are provided from the Metals Control Measures Plan (Woodward-Clyde et al, 1996) and from the Conceptual Model Report (Tetra Tech, 1999). For simplicity, the table does not detail the components of the source loads. Also shown are several supplemental estimates that have been generated as part of the Nickel Action Plan development. Generally speaking, the supplemental loading estimates are similar to or less than previous historical estimates. More detail on how those estimates were made is provided below. The Metals Control Measures Plan provides estimates on an annual basis only, and it does not consider the estimates of sources from the bay's deposited sediments or from the atmosphere.

The largest total nickel load originates from within the bay itself as particulate nickel from the sediment bed. It should be noted that this load has not been directly measured, but has been estimated using a mass-balance model described in the Conceptual Model Report, and thus it is subject to a large uncertainty.

The supplemental loading estimates shown in Table 2-1 use recently collected data to provide comparisons with previous estimates. Thus, those estimates serve primarily as a crosschecking tool. The supplemental estimates were made as follows:

- Total and dissolved loads from tributaries were made using nickel concentration data collected at SB12 on the Guadalupe River by the City of San Jose from 1997-1999, and flow data at the USGS gauging station on the Guadalupe River near San Jose. These estimates were scaled up to the entire watershed using the loading ratio (0.322, Guadalupe River watershed loading to total watershed loading) generated from the loading estimates in the Nickel Source Characterization Report (URS Greiner Woodward-Clyde and Tetra Tech, 1998). The Guadalupe River results are shown in

Table 2-1
Summary of Estimated Total and Dissolved Nickel Loading to the Lower South San Francisco Bay

Nickel Source	Metals Control Measures Plan Estimates (Woodward-Clyde et al 1996), kg/yr	Conceptual Model Report Estimates (Tetra Tech, 1999): Dry Season, kg/dry-season	Conceptual Model Report Estimates (Tetra Tech, 1999): Wet Season, kg/wet-season	Conceptual Model Report Estimates (Tetra Tech, 1999): Annual, kg/yr	Supplemental Estimates	References
POTWs	2056	800	940	1740	1478 kg/yr (1997-1998)	Source Characterization Report (1998)
Tributaries	5500	40	6000	6040	For water years (Oct 1 - Sept 30) 1998 and 1999: 570-660 kg/dry-season; 760-2700 kg/wet-season; 1330-3300 kg/year	Nickel data from SB12, Guadalupe River near San Jose; Flow data from USGS gage Guadalupe River
Atmospheric deposition	–	15	15	30	10 kg/dry-season (Aug 31-Dec 22, 1999) 11 kg/wet-season (Sept 14-Dec 21, 1999)	SF Bay Atmospheric Deposition Pilot Study
Diffuse flux from sediments in Bay	–	360	360	720	–	
Net particulate flux from sediments in Bay	–	16000-18000	15000-16000	31000-34000	–	
Internal Cycling within water column	–	0	0	0	–	

Table 2-1 (continued)
Summary of Estimated Total and Dissolved Nickel Loading to the Lower South San Francisco Bay

Nickel Source	Metals Control Measures Plan Estimates (Woodward-Clyde et al 1996), kg/yr	Conceptual Model Report Estimates (Tetra Tech, 1999): Dry Season, kg/dry-season	Conceptual Model Report Estimates (Tetra Tech, 1999): Wet Season, kg/wet-season	Conceptual Model Report Estimates (Tetra Tech, 1999): Annual, kg/yr	Supplemental Estimates	References
Dissolved Nickel Loadings						
POTWs	–	640	750	1290	90 percent or greater may actually be dissolved	Personal communication with Dave Tucker
Tributaries	–	32	600	632	For water years (Oct 1 - Sept 30) 1998 and 1999: 40-64 kg/dry-season; 100-700 kg/wet-season; 140-764 kg/year	Nickel data from SB12, Guadalupe River near San Jose; Flow data from USGS gage Guadalupe River
Atmospheric deposition	–	0	0	0	–	
Diffusive flux from sediments in Bay	–	360	360	720	–	
Net particulate flux from sediments in Bay	–	0	0	0	–	
Internal cycling within water column	–	700	-590	110	–	

Note:
– = no estimate

Figure 2-1, and the inset shows the loads estimated from the data. The concentrations used for the analyses are shown in Figure 2-2. The average flow between samples was used to generate fluxes.

- Atmospheric deposition estimates were made based on data provided by the San Francisco Bay Atmospheric Deposition Pilot Study, and collected from August to December 1999. The data provided were extrapolated to make estimates for Lower South San Francisco Bay by considering the surface area of the Lower South Bay, and the time period of the dry and wet seasons (assumed to be one-half year each). During the wet season the total atmospheric loading was assumed to be the sum of dry and wet deposition. During the dry season, only dry deposition was assumed to contribute. These supplemental estimates are about two-thirds of those provided in the Conceptual Model Report.

Table 2-1 also summarizes dissolved nickel loading sources. In contrast to the total loads, the dissolved loads do not originate from a single dominating source. Estimates of internal dissolved nickel cycling are provided in the table, and that flux is the same order of magnitude as the largest external dissolved sources during the dry season. The estimate of the internal source was made using the same mass balance approach described in the Conceptual Model Report, and is subject to uncertainty. Since nickel loads are much lower than they were 20 years ago (see Section 1 for details) the large estimated bed particulate flux may actually be from nickel that entered the system years ago and deposited in the bed with the sediments, or from precipitated nickel, since no known sources today are large enough to explain the magnitude of this source.

The most recent data for nickel loadings from POTWs are summarized in Figure 2-3 and detailed in Table 2-2, which also shows discharge, nickel concentrations, and flow rates during both wet and dry periods. These data indicate that the contribution from the POTWs has remained relatively constant during the period 1994 – 1999. Wet season loads are typically higher than the dry season loads.

2.2 Nickel Mass Balance Analyses in Lower South San Francisco Bay

A nickel mass-balance model to support the development and implementation of the Nickel Action Plan within the Lower South San Francisco Bay has been developed and is demonstrated below. Capabilities and limitations of the model are described in the table included in Appendix 1. Also included in the table are comparisons with two other models of increasing sophistication. The model used here is very simplistic and does not simulate nickel cycling processes. The model can be used to estimate how changing the nickel loading from any particular source would influence both dissolved and total water column nickel concentrations. However, the model is no better than the loading data provided, and as discussed above, uncertainties exist with respect to some of the larger nickel loads. The response of the Lower South Bay to changes in the external loads appears to be small, as shown below. Thus, loads could either increase or decrease and if concentration responses are small, such loading changes could go undetected.

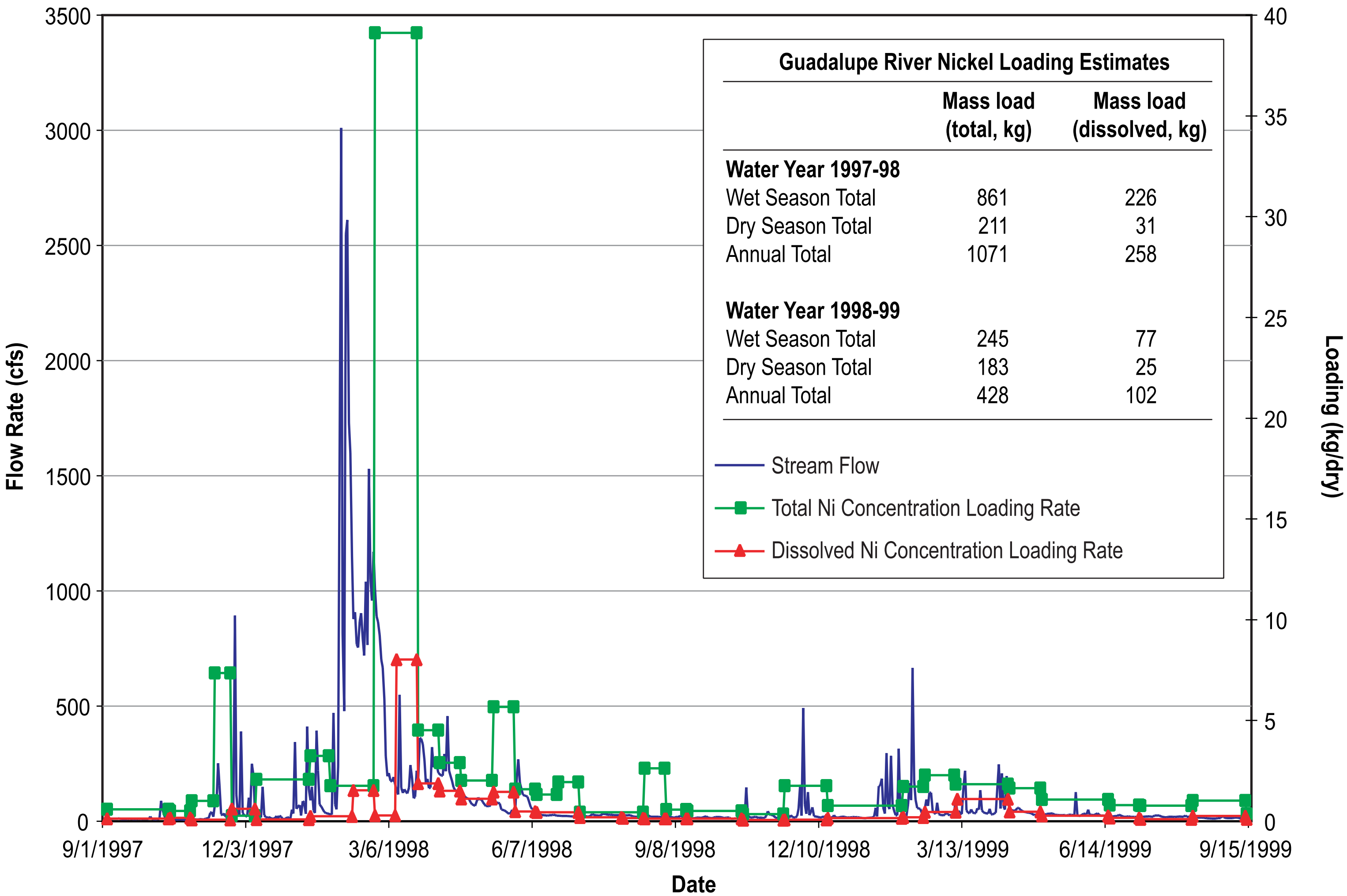


Figure 2-1. Flowrates and nickel loading estimates, Guadalupe River near San Jose.

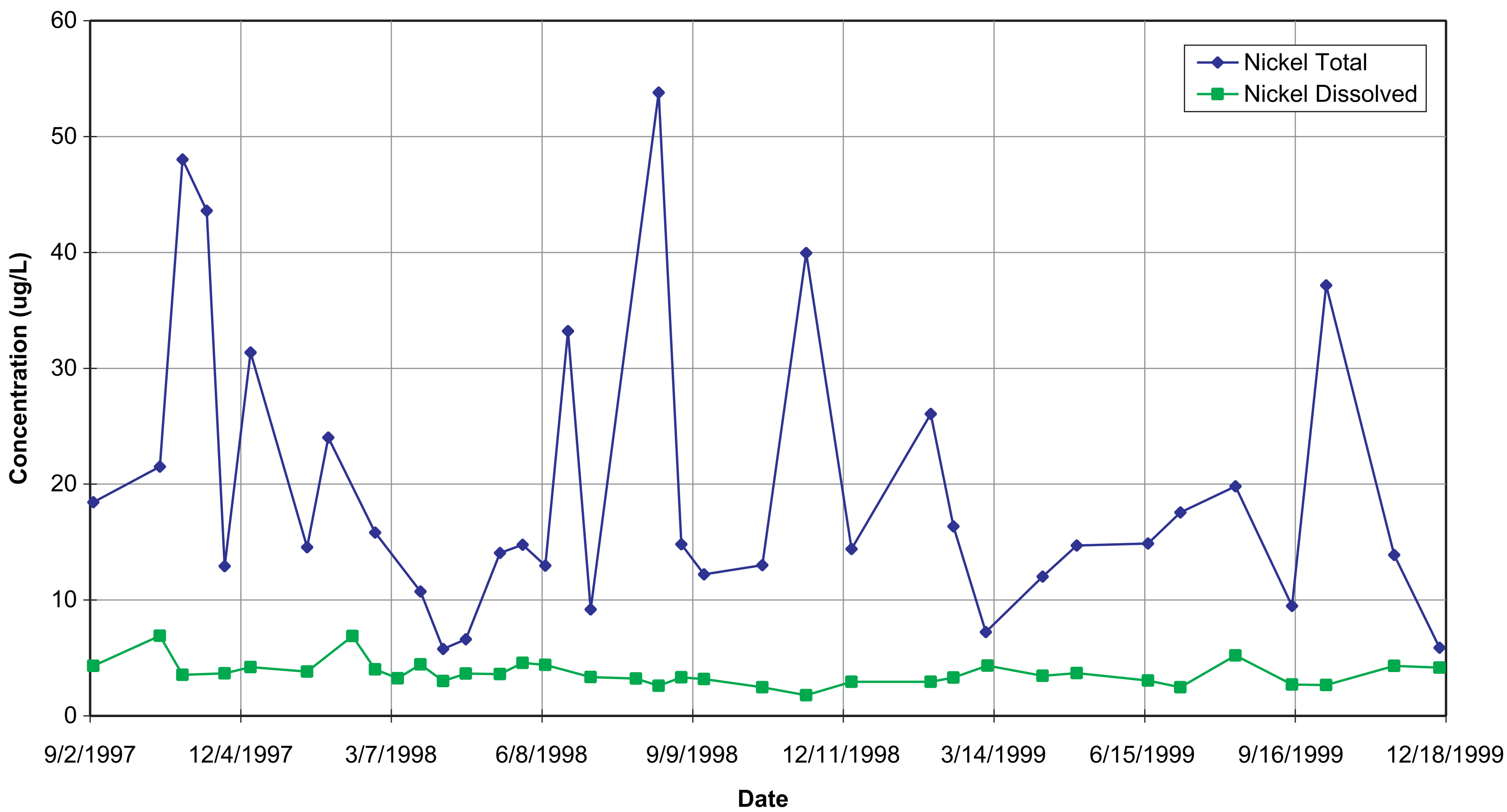


Figure 2-2. Nickel concentrations in the Guadalupe River near San Jose.

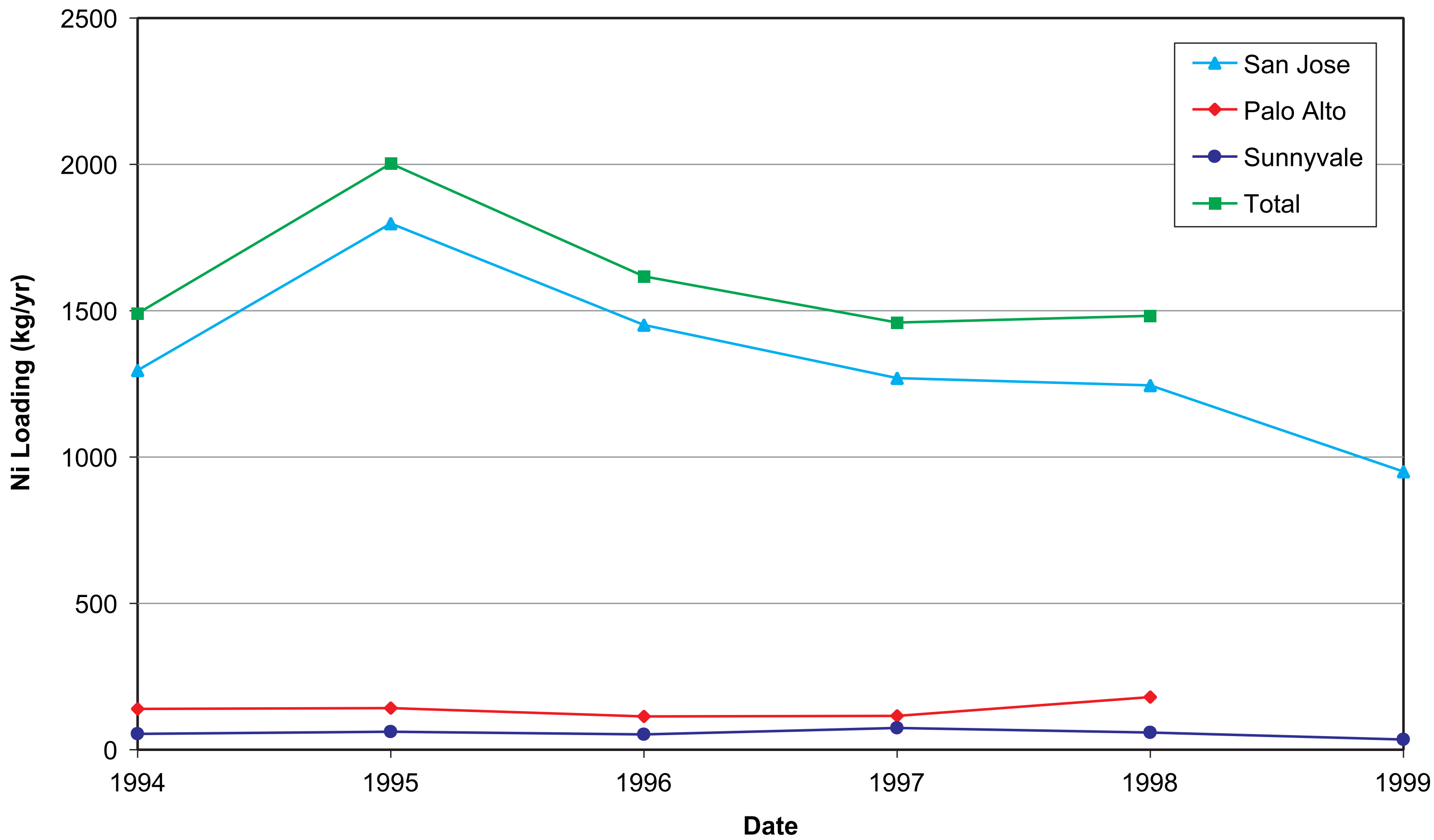


Figure 2-3. Annual nickel loadings from POTWs.

Table 2-2

Nickel Loading Estimates From POTWs, 1994-1999

	Average Flow, MGD					
	SJ		PA		S	
Year	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**
1993-94 (Wet); 1994 (Dry)	105.29	106.46	21.78	22.28	13.26	11.54
1994-95 (Wet); 1995 (Dry)	123.51	123.48	26.00	24.47	16.65	12.58
1995-96 (Wet); 1996 (Dry)	131.87	130.56	27.01	24.55	16.30	14.01
1996-97 (Wet); 1997 (Dry)	132.43	121.90	28.15	24.22	17.62	14.50
1997-98 (Wet); 1998 (Dry)	148.13	127.52	31.25	27.40	19.90	15.49
1998-99 (Wet); 1999 (Dry)	115.12	109.90	no data	no data	16.42	13.15

	Average Nickel Concentration, ug/L					
	SJ		PA		S	
Year	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**
1993-94 (Wet); 1994 (Dry)	9.63	8.14	4.83	4.36	3.18	3.15
1994-95 (Wet); 1995 (Dry)	10.75	10.30	4.79	3.48	3.03	3.13
1995-96 (Wet); 1996 (Dry)	8.76	7.24	3.25	3.10	2.51	2.59
1996-97 (Wet); 1997 (Dry)	6.98	7.47	2.88	3.55	2.47	4.56
1997-98 (Wet); 1998 (Dry)	7.13	5.84	3.85	5.21	2.41	2.37
1998-99 (Wet); 1999 (Dry)	no data	no data	no data	no data	2.58	2.64

	Average Loading, kg/dry-wet season					
	SJ		PA		S	
Year	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**
1993-94 (Wet); 1994 (Dry)	698.93	597.56	72.66	66.94	29.09	25.29
1994-95 (Wet); 1995 (Dry)	918.63	879.93	83.37	58.70	35.61	26.20
1995-96 (Wet); 1996 (Dry)	797.16	653.85	61.01	52.94	27.16	24.91
1996-97 (Wet); 1997 (Dry)	641.78	628.08	56.07	59.37	28.52	45.41
1997-98 (Wet); 1998 (Dry)	724.81	519.81	81.29	98.14	32.96	25.39
1998-99 (Wet); 1999 (Dry)	469.92	480.35	no data	no data	18.97	15.57

Nickel Mass Balance Model and Example Application

The nickel mass balance model uses information on measured water column nickel concentrations, loads of nickel to the Lower South San Francisco Bay, and system geographic information to predict nickel fluxes into and out of Lower South San Francisco Bay, including exchange with the bed, and fluxes past the Dumbarton Bridge. The model is based on mass balance principles, and assumes that the total and dissolved loadings (both internal and external) are balanced by the net loss past the Dumbarton Bridge. The most important information needed to implement this model are loading rates and flushing time estimates. Loading rates have been estimated, as described above, and flushing time estimates for dry weather conditions have been estimated by modeling studies conducted by Stanford University. At present, flushing time estimates for wet weather conditions are not known, and this is a limitation of using the mass balance model with confidence during the wet season. The model can also estimate how each source contributes to the observed concentration in the water column. An example is shown in Table 2-3 shows an application of the model for the dry season. In that table dissolved and total concentrations contributions are shown by source. These contributions are predicted by the mass balance model.

For dry season conditions, the average dissolved and total concentrations are 3.8 μg/L and 23.8 μg/L, respectively. The contributions by source type are shown, add up to the average dissolved and total concentrations. Note that the largest contribution is from the background source, or the concentration that would exist in the Lower South San Francisco Bay in the absence of the remaining sources shown in Table 2-3.This concentration was estimated originally in the Conceptual Model Report, and is the concentration in the central portion of South San Francisco Bay that is uninfluenced by the loads in the table. The background contribution is the largest contributor to the dissolved concentration of 3.8 μg/L, and the second largest contributor to the total concentration (the nickel from resuspended sediments is the largest contributor).

Note especially the predicted nickel concentrations from the POTWs and the tributaries. Relative to the observed concentrations, these contributions are small. This means that the individual contributors to those sources are even smaller since these individual sources are accounted for by the POTWs and tributaries. Thus, the response of the water column concentrations is expected to be small when those loads change, either increase or decrease, within a fairly large range. To express this in another way, if POTW and tributary sources of nickel cease altogether, the dissolved and total concentrations would only change from about 3.8 μg/L and 23.8 μg/L to about 3.0 μg/L (1.6 + 0.46 + 0.89) and 22.8 μg/L (2.5 + 0.02 + 0.46 + 19.8), respectively.

To illustrate that the response of the water column nickel concentrations are insensitive to changes in present day loadings, suppose the dissolved loads were increased by 250 kg/dry-season. This is equivalent to 31 percent of the dry season point source loading. The results are shown in Table 2-4. The concentrations respond by increasing by about 0.3 μg/L. The 0.3 μg/L change would be apportioned over the sources affected as indicated in the table. This analysis assumes the internal cycling rate of dissolved nickel remains the same, as in the base case shown previously in Table 2-3. In actuality, it might change to compensate future loading increase, so that the water column response might be slightly different from the 0.3 μg/l shown.

A parallel set of tables is prepared for the wet season (Tables 2-5 and 2-6). The nickel concentration contributions shown in Table 2-5 add up to the average dissolved and total concentrations for the wet season. In this case the tributaries contribute more than for the dry season, as expected. Note that the responses of water column concentrations are the same as the dry season. This is because the flushing time is assumed to be the same as in the dry season. In actuality, the flushing times could change during storm events, or approach dry season conditions during protracted dry periods.

An alternative to asking “What is the response of the ambient concentration to a loading increase?” is to ask “For a specified concentration increase, what is the increased load that

Table 2-3
Estimated Contributions of Each Source to Typical Dry Season Dissolved and Total Nickel Concentrations in Lower South San Francisco Bay

Source	Dissolved Concentration Contribution, µg/L	Total Concentration Contribution, µg/L
Background	1.6	2.5
POTW	0.81	1.02
Atmospheric	0.00	0.02
Diffusive	0.46	0.46
Tributaries	0.04	0.05
Particulate nickel flux from bed	0.00	19.75
Internal cycling	0.89	0.0
AVERAGE	**3.8**	**23.8**

Table 2-4
Response of Dry Season Nickel Concentration Contributions to 250 kg increase in Dissolved Source Loadings

Source	Dissolved Concentration Contribution, µg/L		Total Concentration Contribution, µg/L	
Background	1.6		2.5	
POTW	1.07		1.32	
Atmospheric	0.00	Plus: Total change = +0.3	0.02	Plus: Total change = +0.3
Diffusive	0.46		0.46	
Tributaries	0.04		0.05	
Particulate nickel flux from bed	0.00		19.75	
Internal cycling	0.89		0.0	
AVERAGE	**4.1**		**24.1**	

Table 2-5
Estimated Contributions of Each Source to Typical Wet Season Dissolved and Total Concentrations in Lower South San Francisco Bay

Source	**Dissolved Concentration Contribution, μg/L**	**Total Concentration Contribution, μg/L**
Background	1.6	2.5
POTW	0.96	1.2
Atmospheric	0.00	0.02
Diffusive	0.46	0.46
Tributaries	0.76	7.64
Particulate nickel flux from bed	0.00	8.78
Internal cycling	-0.88	0.0
AVERAGE	**2.9**	**20.6**

Table 2-6
Response of Wet Season Nickel Concentration Contributions to 250 kg increase in Dissolved Source Loadings

Source	**Dissolved Concentration Contribution, μg/L**		**Total Concentration Contribution, μg/L**	
Background	1.6		2.5	
POTW	1.26		1.52	
Atmospheric	0.00	Plus: Total change = +0.3	0.02	Plus: Total change = +0.3
Diffusive	0.46		0.46	
Tributaries	0.76		7.64	
Particulate nickel flux from bed	0.00		8.78	
Internal cycling	-0.88		0.0	
AVERAGE	**3.2**		**20.9**	

effects such a change?" An example would be, a 0.8 μg/L concentration increase can be related to a load increase of 650 kg/dry-season, based on the mass-balance model predictions.

2.3 Use of "Leading Indicators" and Other Measures to Show Responses of the Bay to Nickel Loading Changes

As discussed in Sections 2.1 and 2.2, the concentration of nickel in the Lower South San Francisco Bay is relatively constant from year to year, with some differences noted between dry and wet seasons. Consequently, it is expected that dissolved nickel concentrations, under present day conditions are relatively insensitive to changes in loadings, as described previously. Hence, there does not appear to be a simple, straightforward approach that would conclusively be better than all others in relating loading changes to responses in the bay. Rather, three alternatives appear as possible candidates, and could jointly be used together. They are:

- Expanding sampling of upland tributaries to provide updated nonpoint source loading estimates, and

- Using leading indictors to qualitatively or quantitatively estimate loading changes.

- Use of quantitative estimates could involve watershed modeling. In bay modeling of the response of the Lower South San Francisco Bay to loading changes.

The first alternative is to expand sampling and monitoring efforts to better estimate tributary source loads, and their variability from year to year. (As shown for the Guadalupe River loading estimates provided previously, the variations between the two years 1997-98 and 1998-99 are considerable.) This information would have direct value because tributary source loadings could be directly calculated from the data collected. Eventually it is expected that relationships between subwatershed loadings would be developed, and the sampling program streamlined. Also, this information would be useful in more sophisticated modeling efforts, should the need for such efforts become apparent.

The second approach is to use leading indicators to forewarn of nickel loading increases. This could be done either in a qualitative sense or in a quantitative sense. Qualitatively, a group of indicators would be chosen such that directions of loading changes would be known for each indicator. The changes in these indicators would be monitored over time. In a purely qualitative fashion, such changes in the indicators may be of limited use. For example, the locations of changes that would go into the indicators (such as locations of new housing starts) would also be needed. Thus, quantitative relationships would be required in conjunction with the use of indicators. Using a watershed model or subwatershed monitoring data would allow for the quantification of the influence of leading indicators, as well as all other processes that affect runoff within the watershed. The EPA's SWMM model has previously been applied to the watershed, and that work could be used as a starting point for future watershed modeling efforts.

Over the past few years since the SWMM model was used, significant advancements in watershed modeling have been made.

Modeling of the bay waters is discussed third as this could be the most complex of the three alternatives (depending on the modeling approach used), and could benefit from the prior implementation of the other two candidate approaches. Modeling is intended to predict how nickel concentration changes are related to loading changes, and can also be used to evaluate response times ("how long will it take for concentrations to respond to loading changes?"). Appendix 1 summarizes alternative modeling strategies, with the simplest ranging from the mass balance model previously discussed to a complex numerical model. The biggest drawback to the complex models is that they would require more detailed loading information than is now available and a better understanding of the processes occurring within the bay (such as internal cycling processes and bed-water column exchanges). At the other extreme of modeling is the present nickel mass balance model. With some straightforward modifications, this tool could be used in a two-step process. Step one would be to use the model as it now stands. This would be as a calibration mode to provide estimates of internal cycling and net nickel flux from the sediment bed. Step two would be to predict the response of the nickel water column concentrations to changes in loadings, keeping the internal cycling and bed exchange constant or changing it in some justifiable manner. An example of such an application would be to start at an existing dissolved nickel concentration of 3.8 μg/L, as in the previous example. Then reduce the dissolved nickel loadings by 250 kg/dry-season. By reapplying the model (step two), the new predicted nickel concentration would be 3.5 μg/L if the internal cycling were kept constant.

Based on the above discussion there does not appear to be a single best approach to address the issue of loadings and responses. In the short term, modifying and using the mass balance model is possible and straightforward. However, the model predictions depend on the loading information provided it and it is the most simplistic of the three model types compared in Appendix 1. A parallel step could be to develop better nonpoint source loading estimates on a year to year (dry and wet season) basis. In the long term, a watershed model linked with a more process oriented model of the bay could provide a valuable tool for assessing changes in the Lower South Bay in a detailed manner. However, such a tool would require significant amounts of input data not yet available, as well as a long-term effort to set up and verify the model. The use of leading indicators is a straightforward approach to help determine how nickel loadings are likely to change, even if such indicators do not make prediction of the actual loads themselves.

3.0 RECOMMENDED INDICATORS, TRIGGERS, AND MONITORING OPTIONS

An objective of the Nickel Action Plan is to establish an indicator or indicators that can be used to ensure that existing water quality is maintained, beneficial uses are protected, and that exceedances of the nickel site specific objective do not occur. The purpose of this section is to provide a basis for using this so called ***'indicator strategy'***. The objective of this strategy is to identify a method or methods that would allow regulators and stakeholders to understand trends in water quality, related to nickel in the LSSFB. Where such measures or indicators show a trend toward increased nickel concentrations, future activities would be initiated in phases.

One or more of the indicators must have an agreed upon measurable point or level that 'triggers' the next set of actions. These 'Phase I and II actions include additional programs, studies or monitoring discussed in Section 4.

For an indicator to be useful in this process it should have the following characteristics:

- Indicator data collection must be relatively cost-efficient and provide a strong certainty of the water quality conditions in the Bay.
- The linkage between the indicator data and the SSO allows a trigger value to be set that is well understood and scientifically accepted.
- The indicator data provides a sound basis for allocating actions to responsible permit holders, i.e., POTWs or urban runoff permittees.

Three indicators are proposed: 1) dissolved nickel concentrations in LSSFB; 2) point source loading of total nickel; and 3) total and dissolved nickel runoff.

The results of the nickel mass balance analyses presented in Section 2 indicate that the nickel concentrations in LSSFB are insensitive to changes in point and non-point loading and that the concentrations of both dissolved and total nickel will remain relatively constant in the foreseeable future. The proposed monitoring effort is intended to confirm these model predictions and to ensure that nickel concentrations do not increase significantly.

Several indicators were discussed during the development of the NAP, but dissolved nickel concentrations in the water column was the most quantifiable indicator of non-degradation available to date and was therefore deemed as the most appropriate to use as a trigger. Tracking the other two selected indicators will provide the ability to see if loading to the system is increasing, remaining relatively constant, or decreasing. Together these three indicators provide the ability to monitor inputs to the system and changes in ambient concentrations.

The selection of these indicators represents a starting point for the NAP. As scientific insight progresses, additional indicators may be identified and incorporated into the monitoring effort. Of particular interest is the development of direct measures of eco-system health and the tracking of so-called leading or sentinel indicators on the composition and magnitude of sources. The efforts to identify and evaluate other indicators are addressed under baseline activities in Section 4.

3.1 Dissolved Nickel Concentrations

The measurement of dissolved nickel concentrations in LSSFB is proposed as the key monitoring parameter to trigger Phase I and Phase II Actions. The information used to select the proposed monitoring strategy as well as the trigger values associated with the monitoring data are described below.

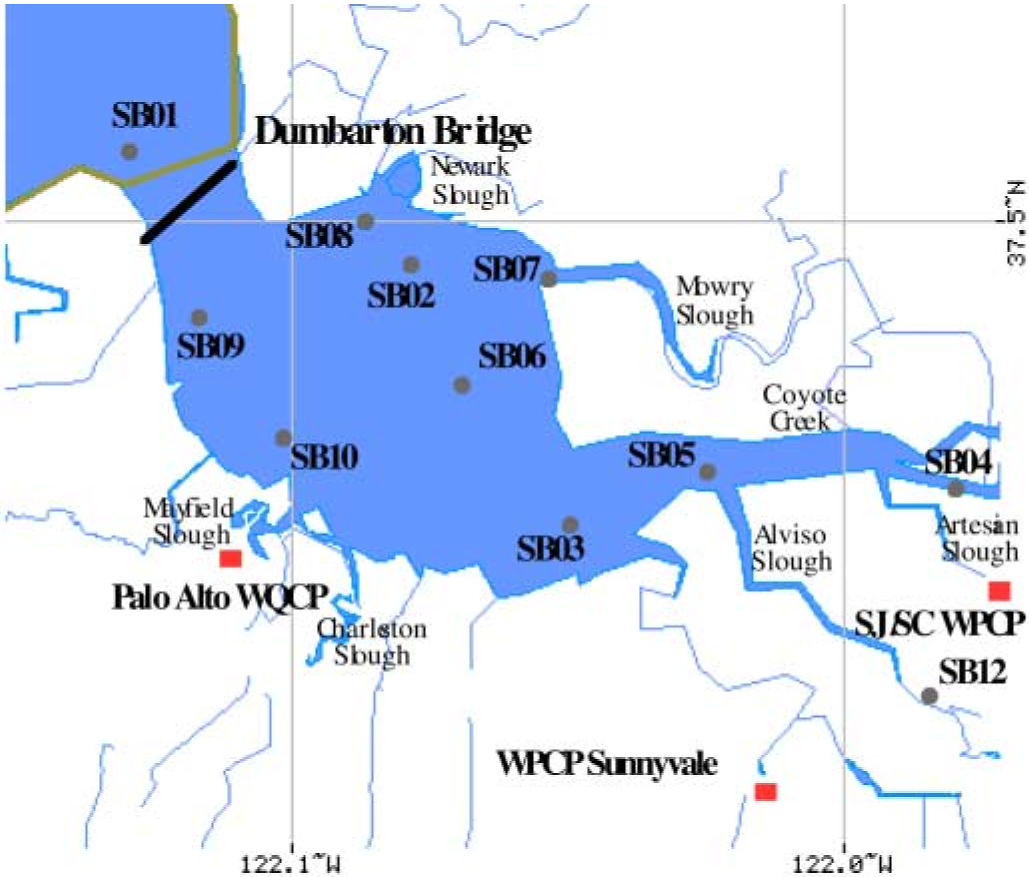
Evaluation of Existing Data

Both total and dissolved nickel concentrations have been systematically measured in the LSSFB since 1989. The most recent data from the City of San Jose's South Bay Monitoring Program were used in the evaluation of existing data and as the basis for evaluating the performance of alternative indicator values. The data included in this analysis were collected bi-weekly at twelve stations in the South Bay (Figure 3-1); triplicate samples were collected at each sampling location and sampling event. The sampling conditions at Stations SB11 and SB12, located in Coyote Creek and Guadalupe River, were distinctively different from the estuarine conditions at the stations in LSSFB, and they were not included in the subsequent analyses described below. In evaluating these data, the first thing that was noted is that there is a statistically significant difference between the mean values of dissolved nickel measured in the wet season (December – May) and the dry season (June – November). Evidence for this can be seen in summary statistics presented in Table 3-1. The dissolved nickel concentrations measured in the dry season are greater than those measured in the wet season at all stations, and all observed differences are statistically significant (Wilcoxon Rank Sum Test, $p < 0.05$). Based on these findings, the dissolved nickel concentration measured in the dry season was used as the indicator in subsequent analyses.

Evaluation of Proposed Monitoring

The use of an indicator requires the specification of a trigger value: the stimulus or value of the quantity (i.e., dissolved nickel concentration) that initiates environmental intervention/action. The first step in specifying a trigger value is the evaluation of the expected performance of the indicator. The evaluation presented below was based on the proposed monitoring effort and the specification of a statistical testing procedure.

The proposed monitoring program would consist of the measurement of dissolved nickel at the 10 stations each month. This would result in six measurements made during the dry season at each station each year. Stations SB11 and SB12 should continue to be monitored, since they provide valuable information on the contribution of nickel from the tributaries.



SBS SITES	REFERENCE LOCATIONS	LONGITUDE	LATITUDE	RMP SITES
SB01	Channel Marker #14	122.08.60W	37.30.48N	BA30
SB02	Channel Marker #16	122.05.04W	37.29.59N	BA20
SB03	Channel Marker #18	122.03.01W	37.27.27N	BA10
SB04	CC Railroad Bridge	121.58.64W	37.27.59N	C-3-0
SB05	LEM site in Coyote Creek	122.01.48W	37.27.84N	
SB06	Between Channel Markers #17 & 18	122.04.30W	37.28.52N	
SB07	Mouth of Mowry Slough	122.03.27W	37.29.54N	
SB08	Mouth of Newark Slough	122.05.41W	37.29.92N	
SB09	Mouth of Mayfield Slough	122.07.08W	37.27.06N	
SB10	Mouth of Charleston Slough	122.05.99W	37.28.19N	
SB11	Standish Dam in CC	121.55.29W	37.27.10N	BW10
SB12	Alviso Yacht Club Dock	121.58.45W	37.25.34N	BW15

South San Francisco Bay site map showing the location of 11 of the 12 stations sampled in the South Bay Study (SBS). Site SB11 located at Standish Dam in Coyote Creek is not within the range of the map presented. The above table indicates analogous sites from the Regional Monitoring Program.

Figure 3-1. Map of monitoring station locations in Lower South San Francisco Bay.

Table 3-1
Descriptive Statistics for Dissolved Nickel Measurements (µg/l) in the South Bay During: a) Wet Season (December – May), and b) Dry Season (June – November). Measurements Made Between June 1997 – March 1999.

a) Wet Season (December - May)

	Mean	Std. Dev.	Std. Error	Count	Minimum	Maximum	# Missing	Coef. Var.
SB01	2.4	.5	.1	18	1.5	3.5	6	.2
SB02	2.6	.6	.1	19	1.6	4.1	5	.2
SB03	3.2	.8	.2	18	1.8	4.9	6	.2
SB04	5.1	1.5	.3	21	2.6	8.5	3	.3
SB05	4.0	1.4	.3	20	1.7	7.3	4	.4
SB06	2.9	.8	.2	20	1.6	5.0	4	.3
SB07	4.0	2.0	.5	19	2.3	10.1	5	.5
SB08	3.0	.6	.1	20	1.7	4.1	4	.2
SB09	2.9	.8	.2	21	1.7	4.7	3	.3
SB10	3.1	.7	.2	19	2.0	4.6	5	.2

b) Dry Season (June - November)

	Mean	Std. Dev.	Std. Error	Count	Minimum	Maximum	# Missing	Coef. Var.
SB01	3.0	.5	.1	21	2.2	3.8	1	.2
SB02	3.4	.7	.2	20	2.5	5.3	2	.2
SB03	4.1	.9	.2	20	3.2	6.5	2	.2
SB04	6.7	2.1	.5	20	4.0	13.4	2	.3
SB05	4.9	1.4	.3	20	3.4	7.4	2	.3
SB06	4.0	1.1	.3	20	2.8	6.6	2	.3
SB07	4.6	1.2	.3	20	3.0	7.2	2	.3
SB08	3.8	.8	.2	20	2.7	5.3	2	.2
SB09	3.4	.7	.2	20	2.5	5.7	2	.2
SB10	3.8	.6	.1	19	2.7	5.4	3	.2

Examination of the data in Table 3-1(b) indicates that there is considerable variability in the dissolved nickel concentrations between stations, but the variability between the measurements made at each station is low. For example, the difference between the lowest mean value (3.0 μg/l at SB01) and the highest mean value (6.7 μg/l at SB04) is a factor of two. However, the coefficients of variation at all 10 stations are extremely low (< 0.30 or 30 % of the mean value).

In these analyses, a further step was taken to examine the inherent variability in these measurements and to evaluate alternative indicator values. All ten stations were ranked by dissolved nickel concentration from lowest to highest value. Then, the stations with the two lowest and two highest values were removed. This resulted in six stations (SB03, SB06, SB07, SB08, SB09, and SB10) with mean values between 3.4 and 4.6 μg/l, and coefficients of variation between 0.20 and 0.30. These stations are referred to as the Indicator Test Stations. It is envisioned that the measurements at these locations would be pooled for statistical comparisons between a baseline year (e.g., 1997) and each subsequent year. Pooling the samples would give a sample size of approximately 30.

These preliminary analyses indicate that the dissolved nickel concentrations in the South Bay exhibit characteristics that are requisite for indicators: low variability both temporally and spatially. The use of dissolved nickel concentrations in the dry season has the added benefit that the measurements are less likely to be influenced by natural phenomena. For example, it seems likely that the concentrations of dissolved nickel in the wet season are influenced by the occurrence and magnitude of storm events.

Evaluation of Indicator Performance

To evaluate the expected performance of the proposed indicator, statistical power analyses were conducted. These analyses provide estimates of the minimum, statistically-significant differences that can be detected between measured values. There are several required specifications for these analyses that are a fundamental part of the indicator definition. The first of these is the proposed testing procedure, i.e., statistical test that will be used and the level of sampling effort.

In the proposed testing protocol, the Wilcoxon Rank Sum Test (WRS) would be used to test for differences between the mean values at the Indicator Test Stations. The WRS can be described by a shift model which assumes that the two populations from which the dissolved nickel measurements were made differ by or are shifted by an amount Δ, which is constant (i.e., independent of the magnitude of the measured values). The WRS can be viewed as a test for the existence of a shift (Δ) between two populations or a test for differences in the central tendency of the distribution (mean or median) of the dissolved nickel concentrations measured at the end of each dry season sampling period. These comparisons would be made to determine if an increase in the ambient dissolved nickel concentrations has occurred.

Statistical power analyses were conducted to determine the power of the WRS test, i.e., the ability to detect specified level of shift (Δ) between the underlying sample distributions under selected test conditions. Monte Carlo simulation methods were used to conduct the power analyses. In these analyses, level of shift (Δ) was specified as a proportion of the value of the mean under existing conditions (μ_1 = 4.0 μg/l). For selected values of the coefficient of variation and sample size (n_1 and n_2), the values of the means from the two distributions were set at μ_1 and $\mu_2 = \mu_1 + \Delta$, where Δ = 0.2, 0.4, 0.6, 0.8, 1.0, or 1.2. These test conditions were then repeated in power analyses (100,000 simulations were run for each test case) to determine the probability of detecting a shift (Δ) of the specified magnitude.

The results of these analyses are presented in Tables 3-2 to 3-4. In each table, the power or probability of detecting a specified change in the dissolved nickel concentration is shown for different numbers of samples and different levels of change. The difference in these tables is that the level of variability (coefficient of variation) in Table 3-2 is 0.20 and in Table 3-4 is 0.35.

The results in both tables can be used to bracket the expected performance of dissolved nickel concentrations as an indicator. For example, using the results in Table 3-2: with equal sample sizes of 30, the probability of detecting a shift in the concentration of dissolved nickel concentration of 1.2 μg/l is 1.0 (results rounded: 0.99 < actual probability <1.0). That is, if the mean concentration at an individual sampling station is 4.0 μg/l in 1997, an increase of greater than 1.2 μg/l to 5.2 μg/l in any subsequent year is virtually certain to be detected. Referring to the results in Table 3-4, the probability of detecting the same level of change, when the coefficient of variation is increased from 0.20 to 0.35, is 0.89, i.e., there is an eighty-nine percent chance of detecting this level of change.

The results presented in Tables 3-2, 3-3, and 3-4 demonstrate the ability to predict the likelihood of detecting specified levels of change that might occur on an annual basis. Based on this information and the fact that the lower end of the proposed Site Specific Objective for nickel is 11.6 μg/l, the proposed Phase I and Phase II trigger levels described in Section 1 are 6.0 μg/l (Δ = 2.0) and 8.0 μg/l (Δ = 4.0 μg/l or an increase by a factor of two), respectively.

Application of Indicators

There are two key elements of the indicator-trigger strategy. The first is the process by which established indicators are monitored and triggers employed. The second element is the process for establishing additional indicators and trigger levels.

The recommended monitoring program for dissolved nickel concentrations in the LSSB would be conducted at the Baseline level. If annual monitoring results show that the first trigger level is reached (i.e., mean concentrations of dissolved nickel at the six Indicator Test Stations increase by 2.0 μg/l or more), this would indicate that the trends in the LSSB are of concern, and the Phase I activities discussed in Table 4-2 would be initiated. Such activities would include recommended additional measures or “indicator” development that should be tracked for establishing additional triggers that would initiate Phase II activities. If the recommended monitoring program shows that Phase II trigger levels are present then it is assumed that the beneficial uses in the LSSB are threatened. This initiates a much higher level of program activities that are discussed in Section 4.

Table 3-2 Power Analysis for Wilcoxon Rank Sum Test: Coefficient of Variation = 0.20

n_1	n_2	Δ	Power
15	15	0.2	0.09
20	20	0.2	0.12
25	25	0.2	0.13
30	30	0.2	0.16
40	40	0.2	0.20
15	15	0.4	0.25
20	20	0.4	0.32
25	25	0.4	0.39
30	30	0.4	0.47
40	40	0.4	0.58
15	15	0.6	0.49
20	20	0.6	0.62
25	25	0.6	0.72
30	30	0.6	0.79
40	40	0.6	0.90
15	15	0.8	0.73
20	20	0.8	0.85
25	25	0.8	0.93
30	30	0.8	0.95
40	40	0.8	0.99
15	15	1.0	0.90
20	20	1.0	0.96
25	25	1.0	0.99
30	30	1.0	1.00
40	40	1.0	1.00
15	15	1.2	0.97
20	20	1.2	0.99
25	25	1.2	1.00
30	30	1.2	1.00
40	40	1.2	1.00

Table 3-3 Power Analysis for Wilcoxon Rank Sum Test: Coefficient of Variation = 0.25

n_1	n_2	Δ	Power
15	15	0.2	0.09
20	20	0.2	0.09
25	25	0.2	0.10
30	30	0.2	0.11
40	40	0.2	0.13
15	15	0.4	0.18
20	20	0.4	0.24
25	25	0.4	0.28
30	30	0.4	0.33
40	40	0.4	0.40
15	15	0.6	0.34
20	20	0.6	0.44
25	25	0.6	0.51
30	30	0.6	0.59
40	40	0.6	0.73
15	15	0.8	0.52
20	20	0.8	0.66
25	25	0.8	0.77
30	30	0.8	0.86
40	40	0.8	0.93
15	15	1.0	0.73
20	20	1.0	0.86
25	25	1.0	0.91
30	30	1.0	0.96
40	40	1.0	0.99
15	15	1.2	0.87
20	20	1.2	0.95
25	25	1.2	0.98
30	30	1.2	0.99
40	40	1.2	1.00

Table 3-4 Power Analysis for Wilcoxon Rank Sum Test: Coefficient of Variation = 0.35

n_1	n_2	Δ	Power
15	15	0.2	0.06
20	20	0.2	0.07
25	25	0.2	0.07
30	30	0.2	0.09
40	40	0.2	0.10
15	15	0.4	0.12
20	20	0.4	0.13
25	25	0.4	0.17
30	30	0.4	0.18
40	40	0.4	0.24
15	15	0.6	0.19
20	20	0.6	0.25
25	25	0.6	0.31
30	30	0.6	0.36
40	40	0.6	0.46
15	15	0.8	0.30
20	20	0.8	0.41
25	25	0.8	0.50
30	30	0.8	0.56
40	40	0.8	0.71
15	15	1.0	0.45
20	20	1.0	0.57
25	25	1.0	0.66
30	30	1.0	0.76
40	40	1.0	0.86
15	15	1.2	0.60
20	20	1.2	0.73
25	25	1.2	0.81
30	30	1.2	0.89
40	40	1.2	0.95

The incorporation of indicators and triggers into the monitoring program is part of the overall adaptive management strategy adopted by the NAP. As noted in the NAP Update Cycle (Section 1), the NAP will be updated to incorporate lessons learned from baseline action items and scientific and technical information from other sources. New indicators can be added, new trigger values can be selected, and the monitoring strategy revised.

4.0 IDENTIFICATION AND EVALUATION OF ACTION ITEMS

The purposes of this section of the Nickel Action Plan are:

- Identify control/pollution prevention measures that have previously been implemented, are currently being implemented, or are currently under investigation for potential implementation by South Bay POTWs, the SCVURPPP, and/or other organizations to reduce nickel loading to the Lower South San Francisco Bay.

- Identify those potential control/pollution prevention measures that should be investigated and potentially implemented based on the results of the Nickel Action Plan monitoring program.

- Identify monitoring/data collection measures that should be further developed to provide for future alternative control/pollution prevention related triggers that are linked to a specific source.

Baseline control measures are identified in Table 4-1. The Baseline control measures represent those measures/actions that are currently ongoing and/or under investigation. It is assumed that these Baseline measures will continue to be implemented through current storm water and POTW programs. Improvements in the measures/actions are anticipated to occur through routine operations. Reporting on the result/effectiveness of these measures will occur through routine permit reporting mechanisms noted in the table.

Potential Phase I control measures are identified in Table 4-2. As noted in Table 4-2, potential Phase II control measures will be identified as part of control measure I-12.

Table 4-1
Summary of Baseline Nickel Control Actions[1]

Baseline Number	Continuous Improvement[2]	Description	Lead Party	Implementation Time-Frame	Implementation Mechanism	Source (s) addressed; potential effectiveness
NB-1	C-9, C-10, C-25, C-30 (B-8), C-31 (B-21)	Co-permittees and SCVURPPP continue to implement Performance Standards Continue to implement URMP (Metals Control Measures Plan[3]): EROSION-1 *Implement performance standards for construction inspection.* EROSION-2 *Participate in development of region-wide training and certification program for construction site inspectors.*	SCVURPPP & Co-permittees	Ongoing Workshop for municipal staff on post-construction controls for new development and re-development. Support RWQCB's Annual Workshops for contractors and municipal staff on construction site management and erosion/sediment controls.	Urban Runoff Permit Reporting conducted as part of SCVURPPP and Co-permittees Annual Reports Improve Performance Standards and reporting via SCVURPPP Continuous Improvement process	Major nonpoint source is erosion of native soils, approximately 59% of total nickel load to Lower South Bay
NB-2	(Same as B-10)	Utilize results of SEIDP[4] Indicator #5 (Sediment Characteristics and Contamination) to investigate development of an environmental indicator and investigate the linkage with SFEI sources and loading work effort.	SCVURPPP & Co-permittees (being addressed as part of SCVURPPP permit)	SCVURPPP FY 01-02 Work Plan and 5-Year Monitoring Plan	SCVURPPP & Co-permittees as part of Permit Annual Work Plan and Annual Report	SEIDP Indicator #5 examining relationship between sediment quality and urbanization; unknown effectiveness
NB-3	(Same as B-13)	Track POTW Pretreatment Program efforts and POTW loadings	POTWs	Ongoing	POTW NPDES Permits (reporting part of Annual SMR and Pretreatment Program reports)	Tracking effort
NB-4	(Same as B-14)	Track and encourage water recycling efforts	POTWs	Ongoing	Reporting through POTWs Annual Water Recycling report and/or Annual SMR	POTW; cost-benefits need to be evaluated as part

Table 4-1
Summary of Baseline Nickel Control Actions[1]

Baseline Number	Continuous Improvement[2]	Description	Lead Party	Implementation Time-Frame	Implementation Mechanism	Source (s) addressed; potential effectiveness
						of considering additional efforts
NB-5	(Same as B-15)	Utilize results of SEIDP to evaluate effectiveness of related SCVURPPP Performance Standards and identify cost-effective modifications	SCVURPPP & Co-permittees (being addressed as part of SCVURPPP permit)	SCVURPPP FY 01-02 Work Plan and 5-Year Monitoring Plan	SCVURPPP & Co-permittees Continuous Improvement Process	NA (Potential Environmental indicator(s))
NB-6	(Same as B-19)	Continue to promote industrial water use and reuse efficiency. These programs may include workshops, outreach, incentives, or audits.	POTWs	Ongoing	POTW Permits	Unknown
NB-7		Track and encourage a watershed model linked to a process oriented Bay model	POTWs/SCVURPPP	Ongoing	POTW & SCVURPPP Permits	NA (could allow for better evaluation of water quality changes related to actual/theoretical source reductions; the cost-benefits need to be evaluated as part of considering additional efforts

1 Annual Reports of NPDES permitted agencies (POTWs and SCVURPPP) will contain a summary of the status of all NAP items.
2 References refer to Continuous Improvement activities identified by the Urban Runoff Permit Re-issuance Work Group as part of the SCVURPPP permit re-issuance. "Urban Runoff Permit Re-issuance Work Group --Box 3: Summary of Continuous Improvement Items"(dated June 23, 2000).
3 References refer to measures identified as part of the SCVURPPP Metals Control Measures Plan (MCMP, prepared by WWC/EOA, 1997). MCMP measures are part of the 1997 SCVURPPP Urban Runoff Management Plan (URMP).
4 The Stormwater Environmental Indicators Demonstration Project (SEIDP) is part of USEPA's Environmental Indicators/Measures of success project. The SEIDP is the third phase of EPA's program that focuses on local demonstration projects and the testing of indicators in the Walsh Ave. catchment, water quality indicators, programmatic indicators, social indicators, and site indicators are being evaluated to gauge Program implementation. Twenty different indicators are under review.

Table 4-2
Summary of Potential Phase I Nickel Control Measures

Phase I Number (Dialogue)	Description	Lead Party	Implementation Mechanism	Source (s) addressed; potential effectiveness
(Same as I-3)	Update and re-evaluate source identification (MCMP for nickel and prioritize sources based on effectiveness evaluation of future potential control actions	RWQCB – convene powers to be (see Finding 12 of the POTW permit amendment)	NPDES permits and other CWC regulatory mechanisms	Unknown at current time
(Same as I-7)	Develop Phase II Implementation Plan for POTW expansion of water recycling	POTWs – convene powers to be (see Finding 12 of the POTW permit amendment)	POTW Permits	POTW; cost-benefits need to be evaluated as part of considering additional efforts
(Same as I-10)	Evaluate results of tracking industrial virtual closed-loop wastewater efficiency measures and develop potential actions	POTWs – convene powers to be (see Finding 12 of the POTW permit amendment)	POTW Permits	Unknown at current time
(Same as I-11)	Develop Phase II Implementation Plan for POTW process optimization	POTWs – convene powers to be (see Finding 12 of the POTW permit amendment)	POTW Permits	Unknown at current time
(Same as I-12)	Develop a Phase II Plan including a re-evaluation of Phase I actions and implement if Phase II triggers are exceeded	RWQCB – convene powers to be (see Finding 12 of the POTW permit amendment)	CWC regulatory mechanisms	Unknown at current time
NI-1	Prepare issue paper on the feasibility and cost of alternative reservoir management options	SCVURPPP & Co-permittees	Urban Runoff Permit	Unknown at current time, cost-benefits need to be evaluated as part of considering additional efforts

Table 4-2
Summary of Potential Phase I Nickel Control Measures

Phase I Number (Dialogue)	Description	Lead Party	Implementation Mechanism	Source (s) addressed; potential effectiveness
NI-2	Prepare issue paper on the feasibility and cost of additional rural trail/road controls (follow-up to NB-1 (C-9) and alternative grazing management options	SCVURPPP & Co-permittees	Urban Runoff Permit	Unknown at current time, cost-benefits need to be evaluated as part of considering additional efforts
NI-3	Develop a Phase I Plan including an evaluation of the results Baseline actions	RWQCB – convene powers to be (see Finding 12 of the POTW permit amendment)	CWC regulatory mechanisms	Unknown at current time

Appendix 1
Evaluation of Alternative Modeling Approaches

Appendix 1 Evaluation of Alternative Modeling Approaches			
Category	**Box Model in Conceptual Model Report (Model #1)**	**Box Model with Process Representations (Model #2)**	**Numerical Simulation Model (Model #3)**
Model Description	Model described in conceptual model report, and exercised in Appendix B of that report. This is the most simple of the three models, and is a spatially lumped model.	Box model that predicts continuously the changing copper and nickel concentrations as a result of forcing functions and simplified metal cycling representations	Numerical model such as TRIM or EFDC that predicts copper and nickel concentrations throughout the Lower South Bay (LSB) using the state-of-the-art understanding of copper and nickel process representations
Spatial Resolution and Extent of Modeling Domain	The box model represents Lower South Bay south of the Dumbarton Bridge. No spatial variability is included in the model.	The box model represents Lower South Bay south of the Dumbarton Bridge. No spatial variability is included in the model.	The numerical model is likely to simulate a domain that has a boundary at the Bay Bridge. Detailed spatial resolution is provided in the model
Temporal Resolution	This model considers a dry season and a wet season; two sets of predictions are made, one for each season	The model makes predictions continuously in time over a user-specified period of simulation. Typically predictions will be made on the order of a daily time interval, or less.	The model makes predictions continuously in time over a user-specified period of simulation. Typically predictions are made on the order of an hourly time interval, or less.
Model Output	A single dissolved and total concentration for each metal simulated for the dry and wet seasons; total and dissolved metal fluxes into and out of LSB; estimated mass of metals in water and sediments; concentration contributions by each source.	Time series of dissolved and total metals concentrations in water column over simulation period (spatially lumped, as is Model #1); post-processing results can generate the same types of output as Model #1, but typically as time-series	Concentration distributions of metals simulated at many locations throughout LSB, both in water column and in sediments. Can make predictions at sensitive locations, as needed; post-processing of results can generate additional information, as for Models #1 and #2.

Appendix 1 *(continued)* Evaluation of Alternative Modeling Approaches			
Category	**Box Model in Conceptual Model Report (Model #1)**	**Box Model with Process Representations (Model #2)**	**Numerical Simulation Model (Model #3)**
Effort Required to Complete Data Input	Most data now available; will need to generate better estimates of dissolved metals loading	Same as for model #1; plus data for sediment modeling (e.g. settling velocities)	Location of northern boundary first must be decided; possible new data are loadings north of Dumbarton Bridge; process-oriented data; and data to calibrate/verify the model
Starting Point for Modeling	Conceptual model in Appendix A (Abiotic Component of Copper and Nickel Cycling and Speciation) of report; model has been reviewed by the stakeholders	Possibly start with the modeling work of Monismith at Stanford University; that work was presented at a conference in Monterey in February 1999	Both TRIM and EFDC have been applied to the LSB; and are likely the two best candidates. The applications were to flushing estimation; significant work required to set up these models for purpose at hand.
Effort Needed to Have Models Ready to Predict Responses of Metal Concentrations to Changes in Loadings	One to two months of effort	Three to six months of effort	Six to nine months of effort
Relative Advantages of Each Model	Easiest to use; least amount of input data; easiest to understand	Can predict metal responses to time-varying conditions at relatively small amounts of data requirements	Can be used to focus predictions on sensitive areas in LSB; Can predict responses to specific critical conditions
Relative Disadvantages of Each Model	Its simplicity may make its scientific validity questionable; does not predict spatially variable concentrations (may be able to show this is not important)	Does not predict spatially variable concentrations	Model may require data that are not available, and require simplifications;

Appendix 1 *(continued)* Evaluation of Alternative Modeling Approaches			
Category	**Box Model in Conceptual Model Report (Model #1)**	**Box Model with Process Representations (Model #2)**	**Numerical Simulation Model (Model #3)**
Special Features Possible in Each Model	Uncertainty analysis using Monte Carlo; correlation of variables in Monte Carlo simulations to mimic observed correlations; extended sensitivity analyses easy to implement	Simplified nature of model allows extended periods of analyses to be efficiently performed, but Monte Carlo may be feasible	State-of-the-art process understanding and algorithms can be represented; model can be calibrated/verified, at least to some extent, to demonstrate its applicability.
Applicability of Model to Other Chemicals/Metals of Concern	The concepts of this model are most directly transferable to other metals; for organics that may undergo unique transformation processes, the model is not as applicable	Model can be directly extended to other metals, and also modified to account for processes unique to organic chemicals	This model has a general enough framework to be applied to other metals or to organics; hydrodynamics and sediment transport would be unaffected; limited by process understanding and data availability

Appendix 2
California Regional Water Quality Control Board, San Francisco Bay Region Order No. 00-109 Amending Waste Discharge Requirements

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

ORDER No. 00-109
NPDES PERMIT NOS. CA0037842, CA0037834, CA0037621

AMENDING WASTE DISCHARGE REQUIREMENTS FOR:

CITIES OF SAN JOSE AND SANTA CLARA
SAN JOSE/SANTA CLARA WATER POLLUTION CONTROL PLANT
SAN JOSE
SANTA CLARA COUNTY

CITY OF SUNNYVALE
SUNNYVALE WATER POLLUTION CONTROL PLANT
SUNNYVALE
SANTA CLARA COUNTY

CITY OF PALO ALTO
PALO ALTO REGIONAL WATER QUALITY CONTROL PLANT
PALO ALTO
SANTA CLARA COUNTY

The California Regional Water Quality Control Board, San Francisco Bay Region (hereinafter called the Board) finds that:

1. The Board issued the Cities of San Jose and Santa Clara, Sunnyvale, and Palo Alto (hereinafter the Dischargers) Waste Discharge Requirements, Order Nos. 98-052, 98-053, and 98-054 respectively, on June 17, 1998. Each of the Dischargers owns and operates a wastewater treatment plant which discharges into San Francisco Bay below the Dumbarton Bridge (the "Lower South Bay").

2. Provision 7 of Order No. 98-052 (for San Jose/Santa Clara) states:

   Special Studies Supporting SSO and TMDL Development

   The Discharger shall conduct the following technical work and special studies in support of the development of a TMDL for copper and nickel in the South San Francisco Bay. These special studies will assist the regulatory community to develop site-specific water quality criteria for copper and nickel in the South Bay. The Discharger will conduct the following technical investigations, as appropriate:

Assess Pollutant Levels and Levels of Impairment
Develop technical information to support a site-specific objective for copper and nickel
Assess ambient conditions and effluent levels. Evaluate whether discharge or ambient water exceeds proposed objectives; continue with remaining steps as necessary
Prepare a Conceptual Model of Pollutant Sources
Identify and Recommend Short and Long-term Studies and Implement Short-term Investigations
Evaluate Existing 2-D/3-D Models
Modify Selected Model (as appropriate)
Establish and Support a Stakeholder TMDL Group
Establish and Support a TMDL Technical Review Committee

The Discharger shall develop and submit a schedule and workplan to conduct the appropriate special studies in support of TMDL development that is acceptable to the Executive Officer within 60 days of adoption of this order. The Discharger shall report to the Executive Officer every six months, beginning January 31, 1999 as part of the watershed programs status update, describing its efforts for the prior six months.

3. Each of the Dischargers' orders contains a Provision (Provision 6 of Order No. 98-052, Provision 4 of Order No. 98-053, and Provision 5 of Order No. 98-054), which states:

Watershed Management Initiative Support

The Discharger shall participate with the Regional Board staff, other Dischargers in the Lower South Bay, representatives of the public and other concerned parties as described below in carrying out the Santa Clara Basin Watershed Management Initiative (WMI) tasks set forth in the Bay Monitoring and Modeling Workplan dated July 29, 1997 aimed at development of a TMDL. The Discharger shall participate in such a manner by attending through its representatives meetings of the Core Group of the WMI, as well as meetings of the Bay Modeling and Monitoring Subgroup and the Regulatory Subgroup. The Discharger shall review and comment upon all technical and other proposals developed by the foregoing groups of the WMI. The Discharger shall make technical information in its possession available to the appropriate groups of the WMI necessary to develop the watershed management reports. The Discharger shall report to the Executive Officer every six months, beginning January 31, 1999 as part of the watershed programs status update, describing its efforts for the prior six months in cooperating with the WMI[1].

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[1] This sentence in the Palo Alto permit reads: "The Discharger shall report to the Executive Officer every six months, in the annual and semiannual Pretreatment Program Reports, as part of the watershed programs status update, describing its efforts for the prior six months in cooperating with the WMI.

4. The WMI established the TMDL Workgroup (TWG) as a stakeholder group to advise Discharger TMDL development efforts. The TWG included representatives from the Dischargers, Regional and State Board staff, Santa Clara Valley Urban Runoff Pollution Prevention Program, US EPA, San Francisco Estuary Institute, Department of Fish and Game, environmental groups (CLEAN South Bay and Silicon Valley Toxics Coalition), business groups (Chamber of Commerce, Silicon Valley Manufacturing Group, and the Copper Development Association), Silicon Valley Pollution Prevention Center, and others.

At its April 14, 2000 meeting the TWG approved the following reports and forwarded them to the WMI: <u>Impairment Assessment Report</u> and <u>Copper Action Plan.</u> The TWG also approved an outline of a Nickel Action Plan.

6. The City of San Jose, working through the TWG, produced the following reports and studies in compliance with Provision 7 of Order No. 98-052:

Special Study/Technical Report (San Jose Provision E.7)	**Project Status/Report Title**	**Date San Jose Report Submitted To RWQCB**
Assess Pollutant Levels and Levels of Impairment	*"Task 2. Impairment Assessment Report for Copper and Nickel for South San Francisco Bay"	July 27, 2000
Develop technical information to support a site-specific objective for copper and nickel	"Development of a Site-Specific Water Quality Criterion for Copper in South San Francisco Bay "Acute and Chronic Nickel Toxicity: Development of an Acute-to-Chronic Ratio for West Coast Marine Species"	Copper – June 10, 1998 Nickel – February 18, 1999
Assess ambient conditions and effluent levels. Evaluate whether discharge or ambient water exceeds proposed objectives; continue with remaining steps as necessary	*"Task 2. Impairment Assessment Report for Copper and Nickel for South San Francisco Bay" "Task 2.1 Source Characterization Report"	July 27, 2000 NA
Prepare a Conceptual Model of Pollutant Sources	*"Task 1: Conceptual Model Report for Copper and Nickel in Lower South San Francisco Bay"	June 12, 2000

Special Study/Technical Report (San Jose Provision E.7)	**Project Status/Report Title**	**Date San Jose Report Submitted To RWQCB**
Identify and Recommend Short and Long-term Studies and Implement Short-term Investigations	NA	NA
Evaluate Existing 2-D/3-D Models	*"Task 4: Evaluate Existing 2 and 3 Dimensional Models", dated February 8, 1999	NA
Establish and Support a Stakeholder TMDL Group (TWG)	TWG initiated work on June 23, 1998_ and completed work on _April 14, 2000_____	NA
Establish and Support a TMDL Technical Review Committee (TRC)	TRC process initiated on September 21, 1998____ and completed on April 14, 2000______	NA
Anti-degradation Measures for Copper and Nickel	*"Task 10: Copper Action Plan" *"Task 10: Nickel Action Plan"	NA

7. The <u>Impairment Assessment Report</u> (dated June, 2000) concludes that impairment of the Lower South Bay due to copper or nickel is unlikely. The report also recommends that copper and nickel be removed from the 303d list of impaired water bodies (approved by US EPA on May 12, 1999). Finally the report recommends the establishment of site specific objectives for copper and nickel. The report recommends a range of 5.5 to 11.6 ug/l for dissolved copper and 11.9 to 24.4 ug/l for dissolved nickel as site specific objectives.

8. The <u>Copper Action Plan</u> (dated June, 2000) proposes monitoring to determine if copper is increasing in the Lower South Bay and triggers pollution prevention actions to control copper. For monitoring, the report recommends that copper loading from point sources and urban runoff be monitored. It also recommends that dissolved copper be monitored in the Lower South Bay during the dry season. If the mean dissolved copper concentrations measured at stations specified in this order increases from its current level of 3.2 ug/l to 4.0 ug/l or higher, Phase 1 actions would be triggered to further control copper discharges. If the mean dissolved copper concentration increases to 4.4 ug/l, Phase 2 actions would be triggered. Such incremental increases in mean dissolved copper concentrations

shall be used solely for triggering the aforementioned actions. If the Dischargers demonstrate that the increases in copper concentrations are due to factors beyond the control of the Dischargers, the Board will consider and determine reasonable control actions required under Phase 1 or Phase 2 of the Copper Action Plan.

9. The Copper Action Plan contains specific actions to be done by various entities as appropriate. Those actions applicable to the Dischargers include:

   Baseline Actions: City of Palo Alto efforts to control corrosion of copper pipes (CB-9)[2]; POTW pretreatment programs (CB-13); POTW water recycling programs (CB-14); and Industrial water efficiency efforts (CB-19). In addition, the Dischargers will work with other entities to accomplish other Baseline actions: Industrial runoff reduction (CB-3); Track and encourage investigations of uncertainties in the Lower South Bay impairment decision (CB-17); Track and encourage investigations on factors influencing copper fate and transport (CB-18); and Copper Conceptual Model update (CB-20).

   Phase 1 Actions: Identify copper source increases (CI-3)[3]; Evaluate corrosion controls (CI-4); Expand water recycling (CI-7); Evaluate industrial water efficiency efforts and develop additional actions (CI-10); Develop Phase 2 plan for POTW treatment optimization (CI-11); and Develop plan to re-evaluate actions (CI-12). In addition, the Dischargers will work with other entities to accomplish other Phase I actions: Evaluate and investigate uncertainties in Lower South Bay impairment decision (CI-8); and Evaluate and investigate copper fate (CI-9).

   Phase 2 actions: Reconsider managing stormwater in POTWs (CII-1)[4]; Implement additional corrosion control measures (CII-3); Implement POTW process optimization (CII-6); and Expand water recycling programs (CII-7).

10. The Nickel Action Plan (dated August, 2000) proposes monitoring to determine if nickel is increasing in the Lower South Bay and triggers pollution prevention actions to control nickel. For monitoring, the report recommends that nickel loading from point sources and urban runoff be monitored. It also recommends that dissolved nickel be monitored in the Lower South Bay during the dry season. If the mean dissolved nickel concentrations measured at stations specified in this order increases from its current level of 3.8 ug/l to 6.0 ug/l or higher, Phase 1 actions would be triggered to further control nickel discharges. If the mean dissolved nickel concentration increases to 8.0 ug/l, Phase 2 actions would be triggered. Such incremental increases in mean dissolved nickel concentrations

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[2] Numbers reference Actions described in Table 4-1 (dated August 23, 2000) of the Copper Action Plan, and included in Appendix A to this Order.
[3] Numbers reference Actions described in Table 4-2 (dated August 23, 2000) of the Copper Action Plan and included in Appendix A to this Order.
[4] Numbers reference Actions described in Table 4-3 (dated August 23, 2000) of the Copper Action Plan and included in Appendix A to this Order.

shall be used solely for triggering the aforementioned actions. If the Dischargers demonstrate that the increases in nickel concentrations are due to factors beyond the control of the Dischargers, the Board will consider and determine reasonable control actions required under Phase 1 or Phase 2 of the Nickel Action Plan.

11. The Nickel Action Plan contains specific actions to be done by various entities as appropriate. Those actions applicable to the Dischargers include:

    Baseline Actions: POTW pretreatment programs (NB-3)[5]; POTW water recycling programs (NB-4); Industrial water efficiency efforts (NB-6); and Track and encourage a watershed model linked to a process oriented Bay model (NB-7).

    Phase 1 Actions: Expand water recycling (I-7)[6]; Evaluate industrial water efficiency efforts and develop additional actions (I-10); Develop Phase 2 plan for POTW treatment optimization (I-11); and Develop Phase I Plan (NI-3).

    Phase 2 Actions: Implement actions developed during Phase 1.

12. Some Phase 1 and Phase 2 actions in the Copper Action Plan and Nickel Action Plan may require the assistance of the Board to co-ordinate and assist in the efforts of the Dischargers and other entities to limit or reduce copper and nickel levels in the Lower South Bay. It is the intent of the Board that Board staff will, to the extent practicable, co-ordinate and assist Phase 1 and Phase 2 actions as identified in the Copper Action Plan and Nickel Action Plan

13. Based upon the information contained in the Impairment Assessment Report, the Board hereby concludes that the Lower South Bay is not an impaired water body for copper or nickel within the meaning of Section 303(d) of the federal Clean Water Act. Therefore, it is the intent of the Board to remove copper and nickel for the Lower South Bay from the 303d list of impaired water bodies the next time the list is updated (April 2002). The Board's conclusion is based on data collected in the Lower South Bay from 1997 to 1999 which show that the mean dissolved copper concentration was 2.7 ug/l (range 0.8 to 4.9 ug/l) and that the mean dissolved nickel concentration was 3.8 ug/l (range 1.5 to 10.1 ug/l). Data from the Lower South Bay are below the lowest end of the suggested range for site specific objectives in the Impairment Assessment Report of 5.5 to 11.6 ug/l for dissolved copper and 11.9 to 24.4 ug/l for dissolved nickel as site specific objectives.

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[5] Numbers reference Actions described in Table 4-1 (dated August 23, 2000) of the Nickel Action Plan and included in Appendix A to this Order.
[6] Numbers reference Actions described in Table 4-2 (dated August 23, 2000) of the Nickel Action Plan and included in Appendix A to this Order.

14. It is the intent of the Board to amend the Basin Plan to establish site-specific objectives for copper and nickel for the Lower South Bay. Information contained in the Impairment Assessment Report, along with other information, including information to be developed by the Dischargers for review and consideration by the Regional Board, will be used to establish the objectives. It is the intent of the Regional Board to establish appropriate site specific objectives using available state and/or federal water quality guidance and procedures. It is also the intent of the Board to use the site specific objectives, and all information generated in the process of establishing the site specific objectives, to develop new effluent limits, if needed, for copper and nickel concentration and mass when the dischargers' permits are next revised.

    On March 2, 2000 The State Water Resources Control Board (State Board) adopted the "Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California" (State Implementation Plan – SIP). This Policy establishes procedures for implementing the US EPA's California Toxics Rule. In part, the SIP establishes procedures for Regional Boards to adopt site specific objectives. The following conditions need to be met for a Regional Board to initiate the development of site specific objectives: 1. A written request for a study, including funding commitments and workplans are filed with the Regional Board; 2. Either a. the receiving waters do not meet water quality objectives contained in the California Toxics Rule, or b. a discharger's effluent limits based on water quality objectives contained in the California Toxics Rule cannot be met; and 3. The discharger has demonstrated that effluent limits based on water quality objectives contained in the California Toxics Rule cannot be met by reasonable treatment, source control, and pollution prevention measures.

    The Board finds that the conditions noted in the SIP have been met and therefore a site specific objective study can be initiated. Specifically: 1. The Impairment Assessment Report meets and goes beyond the first condition; 2. The second condition is met since the California Toxics Rule water quality objectives for dissolved copper (3.1 ug/l) and dissolved nickel (8.2 ug/l) are not achieved in the Lower South Bay at all times; and 3. The dischargers have previously implemented reasonable treatment, source control, and pollution prevention measures, without being able to meet potential effluent limits based on water quality objectives contained in the California Toxics Rule.

15. Pollution prevention and minimization are a significant part of the Dischargers' efforts to limit the discharges of copper and nickel.

    a. The dischargers have approved Pretreatment Programs and have established Pollution Prevention Programs under the requirements specified by the Regional Board.

b. The dischargers' Pretreatment and Pollution Prevention Programs have resulted in a significant reduction of toxic pollutants discharged to the treatment plant and to the receiving waters.
c. This reduction is reflected in influent and effluent data.

16. The Board staff has developed the following guidance for a pollution prevention program:

a. The discharger will continue to implement and improve its existing Pollution Prevention Program in order to reduce pollutant loadings to the treatment plant and therefore to the receiving waters. These guidelines are not intended to fulfill the requirements in The Clean Water Enforcement and Pollution Prevention Act of 1999 (Senate Bill 709).

b. The discharger will submit an annual report that includes the following information:
(i) *A brief description of its treatment plant, treatment plant processes and service area*.
(ii) *A discussion of current pollutant issues.* Periodically, the discharger shall analyze its own situation to determine which pollutants are currently a problem and/or which pollutants may be potential future problems. This discussion shall include the reasons why the pollutants were chosen.
(iii) *Identification of sources for pollutants identified in (ii).* This discussion shall include how the discharger intends to estimate and identify sources of the pollutants. The discharger should also identify sources or potential sources not directly within the ability or authority of the discharger to control such as pollutants in the potable water supply and air deposition.
(iv) *Identification of tasks to reduce the sources of pollutants of identified in (ii).*. This discussion shall identify and prioritize tasks to address the discharger's pollutant issues. Tasks can target its industrial, commercial, or residential sectors. The discharger may implement tasks themselves or participate in group, regional, or national tasks that will address these issues. The discharger is strongly encouraged to participate in group, regional, or national tasks that will address its pollutants of concern whenever it is efficient and appropriate to do so. A time line shall be included for the implementation of each task.
(v) *Implementation and continuation of outreach tasks for City employees.* The discharger shall implement outreach tasks for City employees. The overall goal of this task is to inform employees about the pollutant issues, potential sources, and how they might be able to help reduce the discharge of these pollutants into the treatment plant. The discharger may provide a forum for employees to provide input to the Program.

(vi) *Implementation and continuation of a public outreach program*. The discharger shall implement a public outreach program to communicate pollution prevention to its service area. Outreach may include participation in existing community events such as county fairs, initiating new community events such as displays and contests during Pollution Prevention Week, implementation of a school outreach program, conducting plant tours, and providing public information in newspaper articles or advertisements, radio, television stories or spots, newsletters, utility bill inserts, and web site. Information shall be specific to the target audiences. The discharger should coordinate with other agencies as appropriate.

(vii) *Discussion of criteria used to measure Program and tasks' effectiveness*. The discharger shall establish criteria to evaluate the effectiveness of its Pollution Prevention Program. This shall also include a discussion of the specific criteria used to measure the effectiveness of each of the tasks in item b. (iv), b. (v), and b. (vi).

(viii) *Documentation of efforts and progress.* This discussion shall detail all of the discharger's activities in the Pollution Prevention Program during the reporting year.

(ix) *Evaluation of Program and tasks' effectiveness.* This discharger shall utilize the criteria established in b. (vii) to evaluate the Program and tasks' effectiveness.

(x) *Identification of specific tasks and time schedules for future efforts.* Based on the evaluation, the discharger shall detail how it intends to continue or change its tasks in order to more effectively reduce the amount of pollutants to the treatment plant, and subsequently in its effluent.

17. This Order serves to amend NPDES permits, reissuance of which is exempt from the provisions of Chapter 3 (commencing with Section 21100) of Division 13 of the Public Resources Code (CEQA) pursuant to Section 13389 of the California Code.

18. The Dischargers and interested agencies and persons have been notified of the Regional Board's intent to reissue the NPDES permit for this discharge and have been provided an opportunity to submit their written comments and appear at the public hearing.

19. The Board, at a properly noticed public meeting, heard and considered comments pertaining to the discharge.

IT IS HEREBY ORDERED that the Dischargers, in Order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder and the provisions of the Clean Water Act as amended and regulations and guidelines adopted thereunder, shall comply with the following provisions:

Orders Nos. 98-052, 98-053, and 98-054 are amended to add the following provisions:

1. Baseline Actions to control copper and nickel, as described in Findings 9 and 11 and the Copper and Nickel Action Plans, shall be implemented immediately. The Dischargers shall submit annual reports to the Bay Monitoring and Modeling Subgroup of the Santa Clara Basin Watershed Management Initiative and the Board, either included in, or at the same time as, the annual pretreatment report, on the status of these actions. The reports shall be acceptable to the Executive Officer, who will consider comments from the Bay Monitoring and Modeling Subgroup and other interested parties.

2. Ten stations described in the Copper Action Plan shall be monitored monthly during the dry season (May through October) for dissolved copper and nickel. The results of this monitoring shall be reported in the monthly Self Monitoring Reports and in the annual Self Monitoring Report to the Board and to the Bay Monitoring and Modeling (BMM) Subgroup of the Santa Clara Basin Watershed Management Initiative. A Discharger may reference the monthly or annual Self Monitoring Report of another Lower South Bay Discharger to comply with this Provision.

3. If the results of the monitoring required in Provision 2 above for Stations SB03, SB04, SB05, SB07, SB08, and SB09 show that mean dissolved copper concentrations have risen to 4.0 ug/l, the Dischargers shall implement Phase 1 actions described in Finding 9 and report on the Phase 1 actions in the annual report required by Provision 1.

4. If the results of the monitoring required in Provision 2 above for Stations SB03, SB06, SB07, SB08, SB09, and SB10 show that mean dissolved nickel concentrations have risen to 6.0 ug/l, the Dischargers shall implement Phase 1 actions described in Finding 11 and report on the Phase 1 actions in the annual report required by Provision 1.

5. If the results of the monitoring required in Provision 2 above for Stations SB03, SB04, SB05, SB07, SB08, and SB09 show that mean dissolved copper concentrations have risen to 4.4 ug/l, the Dischargers shall implement Phase 2 actions described in Finding 9 and report on the Phase 2 actions in the annual report required by Provision 1.

6. If the results of the monitoring required in Provision 2 above for Stations SB03, SB06, SB07, SB08, SB09, and SB10 show that mean dissolved nickel concentrations have risen to 8.0 ug/l, the Dischargers shall implement Phase 2 actions described in Finding 11 and report on the Phase 2 actions in the annual report required by Provision 1.

7. Provision 6 of Order No. 98-052, Provision 4 of Order No. 98-053, and Provision 5 of Order No. 98-054 are hereby amended to read as follows:

Watershed Management Initiative Support

The Discharger shall participate with the Regional Board staff, other Dischargers in the Lower South Bay, representatives of the public and other concerned parties as described below in carrying out the Santa Clara Basin Watershed Management Initiative (WMI) tasks set forth in a workplan to be approved by the Executive Officer to be developed pursuant to Provision 8 of this Order aimed at assisting the Regional Board select and adopt site-specific water quality objectives for copper and nickel. In addition to conducting the work set forth in Provision 8, the Discharger shall participate in such a manner by attending through its representatives meetings of the Core Group of the WMI, as well as meetings of the Bay Modeling and Monitoring Subgroup and the Regulatory Subgroup. The Discharger shall review and comment upon all technical and other proposals developed by the foregoing groups of the WMI that are related to surface water quality in the Lower South Bay. These technical proposals include, but are not limited to: Track and encourage investigations of uncertainties in the Lower South Bay impairment decision (CB-17); Track and encourage investigations on factors influencing copper and fate and transport (CB-18); and Copper Conceptual Model update (CB-20), from the Copper Action Plan; and Track and Encourage a watershed model linked to a process oriented Bay model (NB-7) from the Nickel Action Plan. The Discharger shall make technical information that is considered public information, in its possession available to the appropriate groups of the WMI necessary to develop and conduct the work effort set forth in the workplan required per Provision 8 of this order. The Discharger shall report to the Executive Officer every six months, beginning January 31, 2001 as part of the watershed program status update, describing its efforts for the prior six months in cooperating with the WMI. The Dischargers shall, in conjunction with the BMM and/or Regulatory Subgroups, schedule semi-annual (twice per year) meetings to discuss tracking efforts and specific efforts that could be undertaken to look for opportunities to encourage specific activities, assign responsibility to execute such encouragement activities, and report on the implementation of previously assigned activities.

8. Provision 7 of Order No. 98-052 is deleted in its entirety. A new Provision is hereby added to each Discharger’s permit as follows:

Technical Assistance to Support the Adoption of Site-Specific Objectives for Copper and Nickel

In support of the WMI's overall goal of developing and implementing site-specific water quality objectives for copper and nickel in the Lower South Bay, the Discharger shall participate with the other POTW Dischargers in the Lower South Bay to conduct the following work to assist the regulatory community to make a final selection of final site-specific objectives for copper and nickel in the Lower South San Francisco Bay and to issue waste discharge requirements to the treatment plants discharging into the Lower South Bay based thereon:

Draft technical and environmental support documents (FED) and summaries thereof for consideration and potential adoption by the Regional Board which are sufficient to enable the Regional Board to select final site-specific objectives for both copper and nickel from within the respective ranges specified in Finding 7 of this Order.

Draft analyses and plans as the Regional Board may need to consider and adopt pursuant to Sections 13241 and 13242 of the California Water Code, as appropriate to enable the Regional Board to comply with the requirements of such Sections in the adoption of site-specific objectives for copper and nickel.

Such further draft analyses and plans as the Regional Board may need to consider and adopt in order to comply with any other requirements of California law in order to adopt final site-specific objectives for copper and nickel and to issue waste discharge requirements to the treatment plants discharging into the Lower South Bay based on such objectives. Such further analyses and plans will be limited to the Regional Board's initial adoption of site specific objectives and waste discharge requirements and not for Regional Board actions in response to challenges of its determinations.

The Discharger shall develop and submit through the Bay Modeling and Monitoring Subgroup of the WMI a schedule and workplan, as part of an updated BMM workplan, to conduct the above work and prepare the above special studies that are acceptable to the Executive Officer within 60 days of adoption of this Order. Such workplan shall provide for a time schedule that will enable the Board to take final action to adopt the final site-specific objectives in as short a time as practicable, but in no case later than three (3) years from the date of adoption of the Order containing this Provision. Such workplan, when approved, shall become the workplan of the WMI. The Discharger shall report to the Executive Officer every six months, beginning July 31, 2001 as part of the watershed program status update (or in the annual and semiannual Pretreatment Program Reports), describing its efforts for the prior six months.

9. As part of the report of waste discharge required 180 days prior to permit expiration for reissuance of the NPDES permits, the Dischargers shall submit revised Copper and Nickel Action Plans. The Plans shall be revised as necessary based on initial data collected and information gained from the initial implementation of the Plans.

10. This Order expires on June 17, 2003.

I, Lawrence P. Kolb, Acting Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on October 18, 2000.

LAWRENCE P. KOLB
Acting Executive Officer